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The 1955 Proceedings

The Proceedings* of the Institute of British Foundrymen for 1955 differ markedly from earlier editions inasmuch as all the papers presented to the London International Congress were sponsored—that is, they were either contributions from the overseas foundry technical associations or from allied British organizations. Respectively, the papers of foreign and UK origin were in the proportion of 12 to four, plus three committee reports emanating from the Technical Council of Institute. Such a restricted number of papers for the Congress, as was pointed out by the president, Dr. Everest, gave adequate time for proper discussion. In the whole volume, the theoretical character of some of the Continental contributions is counterbalanced by the essentially practical nature of the papers presented to the branches of the Institute. The book opens with a full description of the International Congress, the chief guest on these occasions is always the president of the International Committee of Foundry Technical Associations; in London it was Mr. Y. R. W. Granström who held this important office, and the manner in which he carried out his onerous duties gave universal pleasure. His remarks are well worth reading, as they indicate that there are matters other than technology that go to make up a successful industry.

A noteworthy tendency in recent times is the approach to the wider aspects of foundry practice. Thus, when large cast-iron pipe manufacture was a subject for discussion, three sections covered pattern control; loam-block patterns and shell cores for special pipes of large diameter. Again, on an evening devoted to melt-quality tests, the field embraced copper-base alloys; academic aspects and light alloys. Moreover, the same trend is becoming more obvious in many other papers and reports and indicates that foundrymen in general are materially widening their knowledge of techniques used in all branches of the industry.

The Proceedings faithfully mirror, not merely trends, but current developments, as is exemplified by the attention given to the carbon-dioxide process. Moreover, the volume records undiminished enthusiasm for basic knowledge of the behaviour of sands at high temperatures, of the gas content of metals, of ideal feeding conditions, and so forth. These long-term researches will unquestionably result in the better production of good castings at lower cost. Much of this work is due to the co-operative efforts of committees of the Institute and merits high praise. In this issue, a new name appears as Editor, that of Mr. D. Pratt, and we congratulate him on the success of his initial effort, made under quite difficult conditions, due to the incidence of the dispute affecting the printing industry.

*Published by the Institute of British Foundrymen; St. John Street Chambers, Deansgate, Manchester 3; price on application.

The 1955 Proceedings

The Proceedings' somewhat belated appearance detracts nothing from its real worth—that is, as a permanent record of technological achievement in the science and art of castings production. As works of reference, these Proceedings of the Institute are held in the highest esteem throughout the foundry world.

Work of BISRA on Show at Sheffield

Two open days are to be held at the Sheffield laboratories of the British Iron and Steel Research Association—on September 6 and 7—for representatives of member firms. Primarily, these occasions provide the opportunity for demonstrating the progress made by those divisions of BISRA housed at Sheffield—mechanical working, steelmaking, and metallurgy (general)—since the premises were opened late in 1953 by the Duke of Edinburgh. The mechanical working division, for example, will be mounting a series of displays relating to wire drawing (including high-pressure lubrication), work on forging problems, developments in hot and cold rolling, and studies of sheetmetal working characteristics.

The steelmaking division will show various aspects of research into electric-arc furnace operation and economics, advances in ingot feederhead design, and progress in the immersion-casting technique for steel strip. Open-hearth furnace instrumentation will be demonstrated by displays including the BISRA scale model open-hearth furnace equipped with a calorimeter hearth and apparatus necessary for the study of flame characteristics and convective heat transfer. The division's process chemistry section will display the vertical high-temperature globar furnace used in the investigation of sulphur pick-up by melting steel from the impingement of oil droplets. Other aspects of the division's work will be included in the display.

The metallurgy (general) division will have displays relating to electrical sheet research which will include work on the effect of impurities on the magnetic properties of silicon iron, and studies of strain-ageing alpha iron. Also on show will be exhibits illustrating investigations into grain-boundary properties and their relation to internal friction, and studies of static hysteresis curves for soft ferro-magnetic material. An extensive display of advanced methods of analysis will also be mounted, including micro-chemical, absorptiometric, spectrographic, and vacuum fusion methods. The many static displays will be reinforced by a series of working demonstrations—notably of such developments as the continuous casting of steel, and the use of automatic gauge control on the 14-in. experimental rolling mill.

Other sections of BISRA located in London, Swansea, and Normanby will also be represented by minor displays, while the various services developed by the association over recent years will be illustrated.

BRADLEY & COMPANY, LIMITED—Mr. K. H. R. Ham and Mr. F. Watkins have been appointed directors. Mr. Ham, who is secretary of the company, will continue in that capacity, while Mr. Watkins is managing director of Halladays, Limited, manufacturers of metal pressings, of Birmingham, which is a subsidiary of the Bradley group.

Revised Standards for Safety Footwear

The four-year-old British Standard for safety boots and shoes (B.S. 1870) has been revised and is now being published in two separate parts concerned with leather and rubber footwear respectively. The first part, now issued, concerns leather boots and shoes worn by (*a*) general industrial workers and (*b*) miners.

Generally speaking, leather footwear made to B.S. 1870 will wear well and provide workers' toes with good protection against blows. Experience gained by manufacturers and users since the standard was first issued in 1952 has been taken into account in specifying methods of construction and minimum quality of the materials. Boots and shoes covered by the standard have to pass the falling-weight test specified in B.S. 953. This rules that protective toe-caps should be capable of withstanding a blow of 60, 100 or 150 ft. lb. depending on the kind of work to which the boots will be put. Provision is made in the Standard for the use of the BSI certification mark, which may be applied under licence by makers whose products comply with the Standard. A very high proportion of all safety footwear is covered by this mark which nearly 50 manufacturers are licensed to use. Copies of this Standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Price 3s.

Automatic Foundry in Hungary

It is reported that Hungary's first fully-automatic foundry, at the Budapest Electric Machine and Cable Works, has begun test operations. The foundry, said to be "one of the most modern in Europe", will commence production early next year. The output, it is claimed, will be five times greater than normal non-automatic foundry output for comparable premises and one-third fewer workers will be employed. Most jobs will be simply of the push-button type. Engineers are now perfecting ventilating equipment to do away with smoky and steamy working conditions. The foundry has three cupola furnaces with an annual capacity of 11,000 tons each; they will be used in rotation. German, French and Russian plans for foundry mechanization were consulted by Hungarian engineers before erecting the foundry, and the experience gained will be used in the planning of other foundries scheduled to be built in the next five years.

Latest Foundry Statistics

According to the Ministry of Supply, the output of aluminium castings during April was 1,859 tons from sand moulds; 3,809 tons as gravity-die, and 1,292 tons as pressure-die-castings. The three months' production in these branches was 7,567, 16,745, and 5,615 tons respectively. The output of magnesium castings during April was 309 tons.

As reported by the British Bureau of Non-Ferrous Metal Statistics the output of copper-base castings during May was 6,260 tons. The production for the first five months of this year was 32,680 tons, which is 3,410 tons greater than that for the corresponding period of 1955.

Mr. W. ERIC WARD, general works manager responsible for all iron and steel production, has been appointed a local director of the Consett Iron Company, Limited.

Fundamental Considerations for Cupola Operation*

By W. R. Jaeschke

MR. W. R. JAESCHKE, since leaving the Armour Institute of Technology, Chicago, has worked almost entirely as foundry metallurgist and melting supervisor, and has continued on these lines in the sales department, on consulting sales, and field service work on melting equipment, for the Whiting Corporation of Harvey, Illinois. Mr. Jaeschke's experience in foundry melting operations with units such as the cupola, air furnace, side-blower converters, and various combinations of these, covers a period of over 30 years.

(Exchange Paper from the American Foundrymen's Society)

An early study of combustion in a cupola is made and factors of cupola operation that affect the combustion and melting conditions are discussed. Emphasis is placed on the importance of coke quality, material size, stock distribution, and "hang-ups," because in the Author's many years of field service, these important factors have been observed to be most frequently neglected. Finally, the Author considers briefly some accessory equipment that will aid operators to secure greater uniformity, when even the best materials available and the best operating practice do not produce results that meet customer requirements with the equipment available.

Basic Considerations

While the cupola is the oldest and most-popular melting furnace in use in iron-melting foundries, the constantly-changing personnel and the introduction of new ideas require that understanding of the fundamentals of cupola operation is frequently reviewed. The conventional cupola is a "blind" type of melting furnace, that is, there are no openings through which one can observe the actual melting operations, and because of the "blind" nature of this furnace, there has been much discussion about what really goes on inside the cupola.

Inasmuch as melting iron in the cupola is a problem in generation and transfer of heat, a logical starting point might be a study of Bulletin No. 54 of the US Bureau of Mines by A. W. Belden.[1] This Bulletin is a report of a study of the combustion of coke in a cupola. For this study, a 36-in. shell dia. cupola was used. The cupola was 7-ft. 11½-in. high from the bottom plate to the charging opening sill and was lined to 27-in. inside dia. The cupola was equipped with four flared-type tuyeres with an area equal to 16.7 per cent. of the cupola area. Blast was delivered by a positive displacement type blower, and the blast rate was reported as 1,013 cub. ft. per min. Both the tuyere area and the blast rate are slightly less than those of present-day recommendations. Only coke was charged into this cupola, there was no attempt made to melt iron nor was any flux used. The coke was reported to be 3-in. cube and less in size. Gas samples were taken at various points in the coke bed and just below the charging opening sill. The results of the gas analyses of these samples are graphically represented in the sketch shown in Fig. 1. This figure is actually two half-section sketches of the cupola. The half-section sketch on the right is that of Belden's Test No 1, conducted in the straight-wall cupola, while the half-section sketch on the left is that of Test No. 2, conducted in the cupola with the lining boshed from 27-in. to 23-in. inside dia. just above the tuyeres. The gas samples were taken at the points of intersections of the light horizontal and vertical lines at distances from the top of the tuyeres and from the cupola wall as indicated by the dimensions shown on the sketches. The gas analyses are shown at these points, the top figure being the per cent. by volume of carbon dioxide(CO_2), the middle figure is that of oxygen(O_2), and the bottom figure is that of carbon monoxide (CO).

* Presented at the annual conference of the Institute of British Foundrymen in Cardiff, last month.

Inverted Cone

A dotted line has been drawn through the points at which the gas analyses indicate that combustion has been completed. This dotted line forms the proverbial "inverted cone" so often referred to in cupola discussions. The gas analyses reported here confirm the generally-accepted theory that the carbon is first burned to carbon dioxide, and then some of the carbon dioxide is reduced by the incandescent coke to carbon monoxide. The first reaction is relatively rapid and produces heat while the second reaction, fortunately, is slower but consumes heat. Some temperatures were taken with high temperature thermocouples and, as shown in Fig. 1, were only 1,576 deg. F. (860 deg. C.) at the tuyeres, while at the centre of the cupola where combustion was complete it increased to 3,100 deg. F. (1,705 deg. C.) plus. Just how much the temperature rose above 3,100 deg. F. (1,705 deg. C.) was not determined because the thermocouples failed at that temperature.

The zone inward from the line of completed

combustion is a reducing zone where some of the CO_2 is reduced by the incandescent coke to CO, a reducing gas. Some heat is consumed in this reaction, but the CO generated protects the metal charge from excessive oxidation during preheating and melting. The zone between the line of completed combustion and the tuyeres is the combustion zone and is of an oxidizing nature. All the metal should be completely melted before it reaches this zone and such is usually the case when the coke bed is prepared originally to a level above the top of the inverted cone and the subsequent coke charges are heavy enough to maintain the coke bed at that level. Some oxidation of the metal is unavoidable when, in the molten state, it passes through the oxidizing combustion-zone. This oxidation of the molten metal dropping through the combustion zone is responsible for much of the loss of

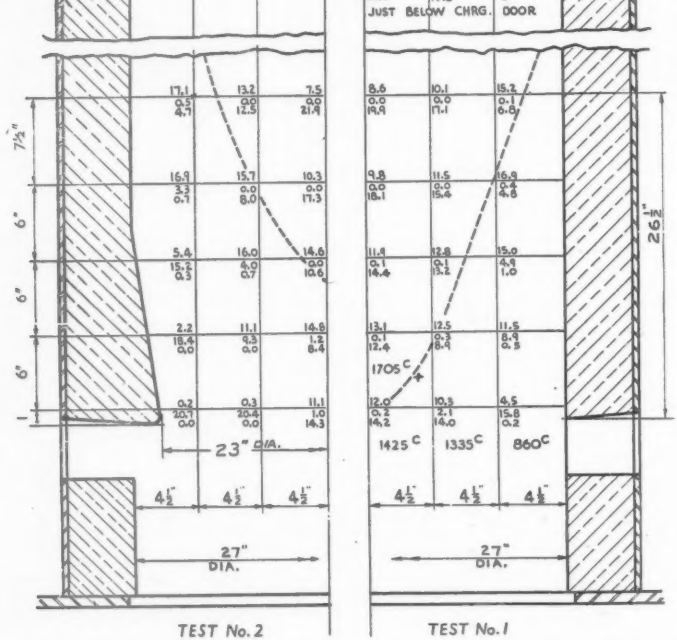


FIG. 1.—*Cupola gas analyses, from A. W. Belden—US Bureau of Mines Bulletin, No. 54. (The groups of figures represent carbon-dioxide, oxygen and carbon-monoxide percentages in that order.)*

lining that occurs in that zone.

Other Pertinent Factors

Many factors, such as lining contour, blast volume, blast velocity, blast temperature, moisture content of the blast, oxygen content of the blast, coke size, burning characteristics of the coke, size of melting stock, and distribution of the melting stock, influence the size and shape of the combustion zone. The ideal combustion zone would be a uniform shallow horizontal section, under which conditions combustion and consequently melting would proceed at a uniform rate over the entire cross-sectional area of the cupola. Then from the coke used the maximum metal temperature, maximum melting rate, and minimum sulphur pick-up, would be obtained.

The half-section sketch on the left of Fig. 1 illustrates the increased penetration of the blast resulting from a boshed lining. The conclusion drawn by the investigators was that combustion conditions were not improved and no further tests were conducted with the boshed lining. While the conclusions drawn may have been warranted for a 27-in. cupola in which no iron was melted and no flux was used, it should be evident that the bosh would be effective in promoting better penetration of the blast for cupolas of larger diameter. Further, if iron and flux charges had been used in the tests for a reasonable length of time, it would have been evident that the boshed lining helped in maintaining cleaner tuyeres.

The size of the oxidizing combustion-zone is partially dependent on the blast rate and as the blast rate is increased, the position of the inverted cone is raised and a higher coke-bed should be used. Even with a higher coke-bed there will be some increase in oxidation because more molten metal will drop through the larger oxidizing combustion-zone at the tuyeres. Conversely, lower blast-rate, higher blast-temperature, lower moisture content of the blast and higher oxygen-content of the blast reduce the size of the combustion-zone and reduce the degree of oxidation.

Large coke creates low resistance to the blast, and with good penetration into the coke bed by the blast, the inverted cone is less deep. Large coke also retards the rate at which CO_2 is reduced to CO and thereby creates a deeper, hotter, superheating zone for melting to higher tapping-temperatures. Small coke, on the other hand, presents considerable resistance to the blast and creates a deep inverted cone. Most melting is then done in a narrow outer ring in the cupola, and more CO gas is produced in the larger reducing zone in the centre of the cupola. The superheating

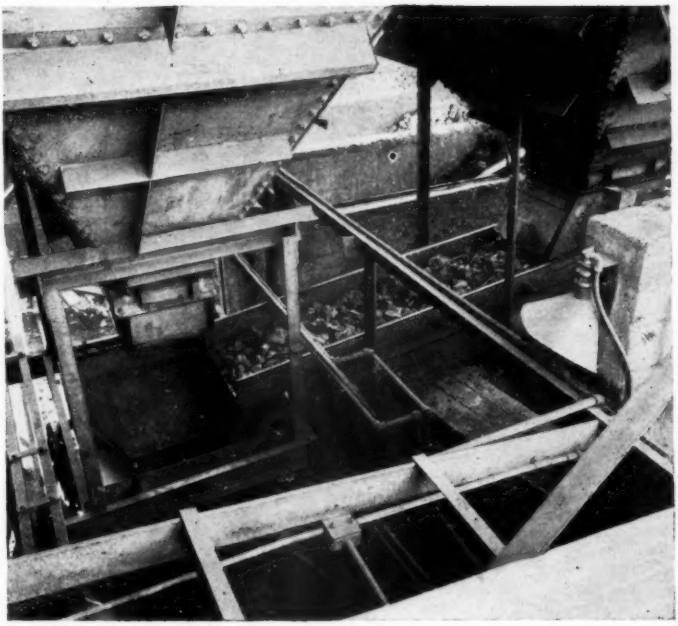


FIG. 2.—*Vibrating coke-feeder arranged for screening-out fines from the weigh hopper when making up charges.*

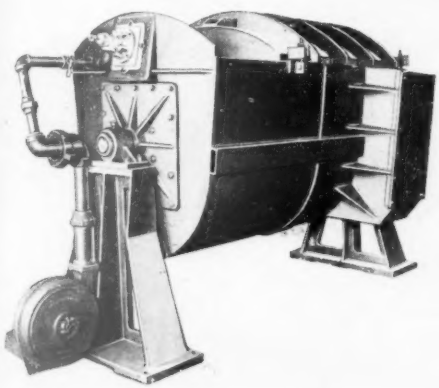
zone is not so deep, more coke is lost to the formation of CO gas, and more coke is then required to melt and superheat the iron to the desired tapping-temperature.

Optimum Conditions

For the best overall results, the coke size should be proportionate to the inside diameter of the cupola.[2] Coke of a size averaging about $\frac{1}{10}$ of the cupola inside diameter, has been found to produce the best results. In hand-charging operations, forking of coke is recommended for rejecting the small coke. In mechanized charge make-up installations, vibratory screens for feeding coke to the weigh hopper are being used to keep small coke out of the charge. Such a screening device is shown in Fig. 2.

Cupola-melting coke should be of high heat value. It should be strong enough as received to permit a reasonable amount of handling and also strong enough at high temperature to support the cupola burden under operating conditions. The coke should be readily combustible by air, but not too reactive with carbon monoxide. It should be low in sulphur, preferably under 0.8 per cent. Coke is frequently required to provide an appreciable portion of the carbon in the iron as tapped, and then its reactivity with molten iron is also an important factor. The lowest fuel costs and the highest melting rates are possible when the charge requires no carbon from the coke and the cupola is then operated at maximum thermal-efficiency. However, under some market conditions, it is possible to make savings in metal costs by using more scrap iron and less pig-iron in the charge. Under these conditions, additional coke or special carbon-raisers will be required to carburize the extra portion of scrap irons.

FIG. 3.—*U-type mixing and desulphurizing ladle, equipped with an oil burner for preheating.*



When scrap irons are used in place of pig-iron, it should be remembered that pig-iron is more uniform than scrap iron in composition, size, cleanliness, and absence of contaminating elements. Attention should then be given to the need for adequate mixing-ladle facilities to level off the greater variations in metal composition and temperature, likely to result from the use of high-scrap mixtures.

Mixing and desulphurizing may be accomplished in U-type ladles[3] (Fig. 3), but some loss in temperature will be incurred. This loss of temperature will be proportionate to the length of time the iron is held in the mixer. Larger-than-normal mixers may be used if they are fuel fired or electrically heated.

Burden Characteristics

Scrap irons vary greatly as to bulk and large scrap is likely to arch or "hang-up" in the cupola, rather than descend at a uniform rate as coke in the bed is being consumed at a uniform rate by the

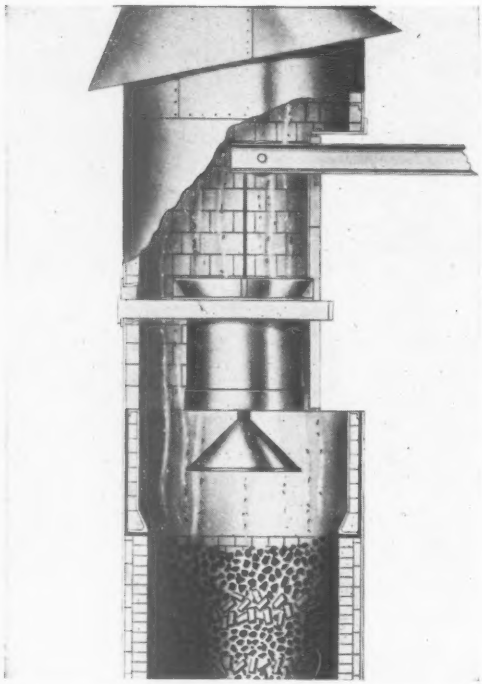


FIG. 4.—*Part sectional view of a cupola shaft showing a cone-bottom bucket for use with crane-type charger.*

constant rate of blast delivered to the cupola. It is assumed, that as coke in the bed is being consumed at a fixed rate, it will be replenished at the same rate by the coke charges that come down as the iron is melted. Any arching or "hang-up" that occurs, retards the gravity flow of the coke to the combustion-zone, while the coke bed is being burned to below its usual level by the constant rate of blast. When the slag becomes darker, the metal temperature drops, and fracture tests indicate harder iron, the operator is aware that the coke bed is too low and adds a booster charge of coke and possibly reduces the blast rate until such time as the booster coke reaches the coke bed. If these "hang-ups" occur frequently, the operator will further protect his operations against excessive oxidation by adding appreciable amounts of "safety" coke to the regular coke-charges. While by these precautions serious operating troubles may be avoided, the melting rate will be reduced, and there will continue to be some variations in the metal as tapped.

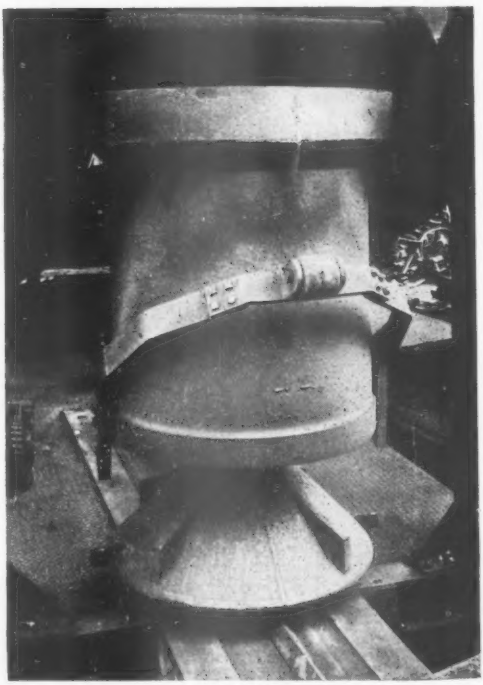
To avoid arching or "hang-ups" of the charges, all metallic constituents should be reduced to a reasonable size, proportional to the size of the cupola. For better melting, the maximum dimension, which is a diagonal, of any piece in the charge should not exceed ⅓ of the cupola inside diameter, or better yet, 30 per cent. of the cupola inside diameter.[4] Extremely small scrap, such as small punchings, or extremely heavy scrap, such as sugar-mill roll shafting, may descend into the combustion zone before they are completely melted and cause excessive oxidation troubles similar to those that result from melting with a coke bed that is too low. Extremely thin materials like loose, thin, sheet-metal trimmings oxidize excessively and should be pressed into bundles or rejected.[5]

Broken light cast-iron scrap is high in the ratio of surface area to mass and has a rapid rate of heat transfer. Since the melting point of cast-iron scrap is low, light cast-iron scrap can be melted more efficiently than can heavy materials such as heavy ingot-mould scrap or heavy steel-shafting. For the best overall results, a scrap should be chosen that approximates the section size of that of the castings being produced. The charges throughout a heat, and from heat to heat, should be as nearly alike physically as well as chemically for the greatest uniformity in the product.[6]

Charging Practice

The shape of the inverted cone can be influenced by the charging practice. In the days of hand-charging, the old masters recommended that the heaviest stock be distributed around the cupola at the lining and to place only light open stock to the

FIG. 5.—*Cone-bottom bucket for use with a skip-type charger.*



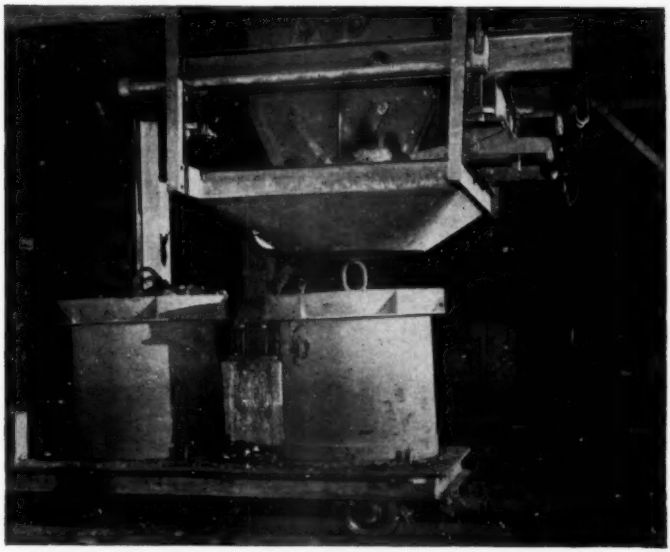


FIG. 6.—*Weigh hopper for the metallic portion, when the charge is made up by electro-magnet and crane. The charge is dropped vertically into a cone-bottom bucket.*

centre. Coke and limestone were to be spread over the whole charge. The purpose of this selective distribution of the charge was to create greater density of the charge at the lining, but less density or more permeability in the centre to counteract the tendency of the blast and hot gases to channel up along the lining instead of through the bulk of the charge.

Mechanically, this variation of density in the charged column is possible only when charging from a uniformly-loaded cone-bottom bucket. With this manner of stock distribution, there will be better blast-penetration, more uniform combustion and melting over the whole cross-sectional area of the cupola. Then from the coke used, the maximum metal temperature, maximum melting rate, minimum oxidation and minimum sulphur increase in the metal will be obtained.[5] Fig. 4 is an illustration of a cone-bottom bucket for a crane-type charger and Fig. 5 is an illustration of such a bucket for a skip-type charger. Fig. 6 illustrates the best mechanical method for loading the cone-bottom bucket.

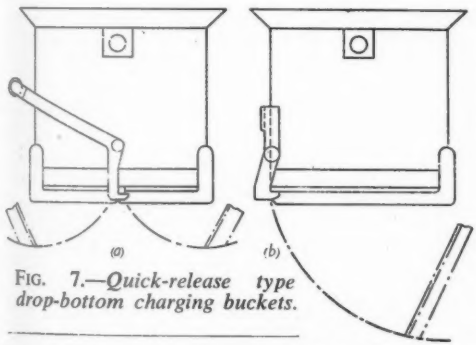


FIG. 7.—*Quick-release type drop-bottom charging buckets.*

From the iron weigh hopper the charge is dropped vertically into the bucket for uniform loading. Chute loading is no more satisfactory for loading a cone-bottom charging bucket than it is for charging a cupola. Cone-bottom buckets are of the slow-release type and the charge is practically dribbled into the cupola with a minimum of impact.

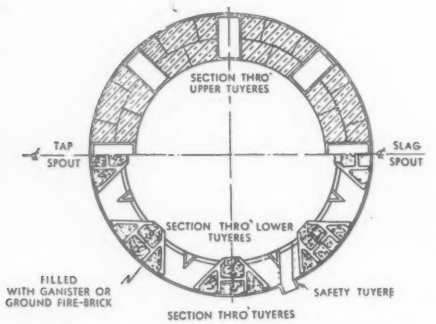
Other types of charging buckets tend to drop the material into the cupola in humps. From chute-type chargers or " over-the-lip " type as they are sometimes referred to, the hump is most likely to be on the side opposite the charging opening. Some segregation of the material also results from this manner of charging, particularly of the limestone. The limestone is most likely to channel down directly under the charging opening, scouring the lining deeply on this side while the tuyeres on the opposite side, bridge heavily. The blast and hot gases then channel up the clean open section instead of up through the whole charged column.

Drop-bottom buckets of the quick-release type drop the charge densely in an inner ring of the cupola with considerable impact and the charged column is dense in the centre and loose and permeable at the lining. Consequently, the blast and hot gases channel up along the lining and most of the melting is done in a narrow outer ring. Fig. 7 illustrates two types of quick-release drop-bottom buckets. Drop-bottom buckets of the slow-release type drop the charges in one or two densely-packed humps, depending on whether the bottom halves are hinged on the outside or along a centre line. The blast and hot gases then seek the loosely-packed valleys, or valley in the case of the centre-hinged bucket, and melting will follow in the same pattern.

Air Supply

Two rows of staggered tuyeres are used by some operators to minimize the bridging encountered in cold-blast operations. With less bridging, there is less resistance to the blast and more uniform melting rates and metal temperatures are obtained throughout the heat (see Fig. 8). In British Balanced-Blast cupolas, three rows of tuyeres are used and the main row is equipped with tight shut-off gates that are closed and opened in regular sequence to deslag the tuyeres. In the USA some of the BBB cupolas

are equipped with air cylinders automatically controlled to operate the main tuyere deslagging valves in regular sequence (see Fig. 9). These cupolas are particularly popular in cast-iron pipe foundries where a tapping temperature of 1,400 deg. C. is satisfactory and coke consumption is down to about 6½ per cent. with correspondingly high melting rates. In some European foundries, the writer has seen other types of deslagging tuyere arrangements that should be effective, provided the blast shut-off valves are closed tightly. Loose, leaky deslagging shut-off gates are not effective nor will the idea work successfully on continuous types of tuyeres.



Preheated blast increases the ignition rate of coke and increases the temperature of combustion. The oxidizing combustion-zone is reduced in size by the faster rate of combustion and there is less bridging, less oxidation of the metal and less erosion of the lining in the combustion zone. The higher temperature of combustion permits a saving in fuel, a higher tapping temperature or some combination of both. In the USA, preheated blast temperatures for conventional acid-lined cupolas range from 175 to 370 deg. C., with coke savings of from 20 to 35 per cent.[7] The value of preheated ballast increases as coke quality decreases. With less oxidation and more fluid slag, sulphur absorption by the metal is less than with cold-blast operation. Melting rates may be increased in proportion to the fuel savings.

Operating Controls

Moisture control[8] of the blast is being practiced in the USA to a mentionable extent. By controlling moisture in the cupola blast to from 3 to 4 grains per cub. ft. throughout the seasons of the year, piston ring, malleable duplex melting, and some grey-iron foundries have been able to reduce oxidation losses and obtain greater uniformity in composition and structure of their products. Greater uniformity of the metal results in lower scrap losses and an opportunity to reduce expensive factors of safety in foundry operations. For instance, in a malleable duplex-melting system operating with moisture control of the cupola blast, the metal has a more uniform annealing characteristic than when atmospheric blast is used, and the annealing-time cycle may be reduced closer to the minimum requirements.[9]

With all the finest care exercised in the operation of a cupola, it may still be possible that the variations in the coke and scrap materials used, cause more variations in the castings than some customers can allow. In that case, further refinements may be had by duplexing the cupola-melted metal through large-capacity heated metal mixers. A heated metal-mixer may be a fuel-fired tilting-type reverberatory furnace or an electric furnace. In the USA, pulverized coal-fired, or oil-fired reverberatory furnaces and direct-arc electric furnaces are used for this purpose. Besides improving the uniformity in composition and temperature, the large mixer acts as a cushion between the melting and production departments. Short delays in either department do not necessarily cause a delay in the other one. Besides providing improved uniformity in the metal composition and temperature, it thereby helps maintain the maximum production rate.

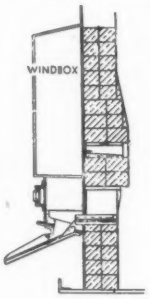


FIG. 8.—*Section and elevation of lower part of a cupola showing two rows of staggered tuyeres used in conventional designs.*

Fig. 10 is one of several cupola-operation charts found in the AFS handbook "The Cupola and Its Operation." These charts are the result of interpolations by Massari and Lindsay[10] of earlier

FIG. 9.—*Lower part of a British Balanced-Blast type cupola equipped with automatically-operated de-slagging tuyere valves.*

research work done by Jungbluth and Korschan. The charts show the relationship between metal temperature, melting rate, blast rate, and iron to carbon ratio. The Author has found these charts to be closely representative of cold-blast cupola operation when coke and the metallics of the charge are of average characteristics. These charts serve as helpful guides to cupola operators.

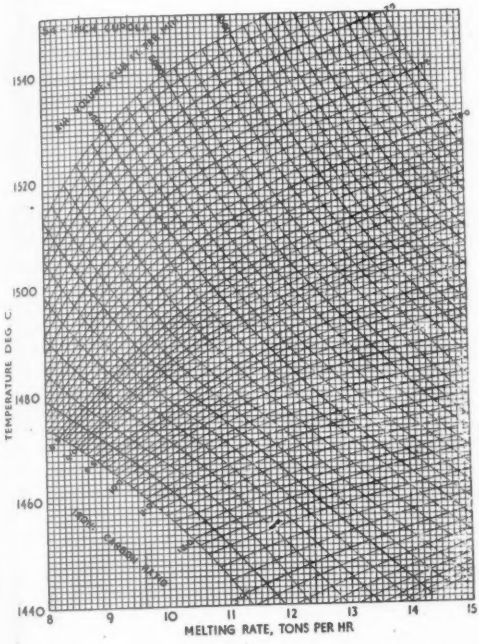


FIG. 10.—*Operation chart for a 54-in. dia. cupola.*

Operation Chart

Table I was prepared from the operation chart for a 54-in. inside dia. cupola for a fixed blast rate of 5,200 cub. ft. per min. This table illustrates the rapid rise in coke costs for increasing metal temperatures. High metal temperature requirements may be due to unnecessarily high losses of temperature in the foundry because of the use of thinly lined open-top ladles, or to many metal transfers between the cupola spout and the mould. Fig. 11 is a chart that illustrates some of the improvements achieved in a malleable foundry, duplex melting from cupola to direct-arc electric furnace.[11] Preheated blast was applied to the cupola and thinly-lined open-top ladles were replaced by heavily-lined covered ladles. These changes resulted in reduced power and refractory costs in the electric furnace, a better and safer pouring range for the castings, besides savings and improved operating conditions at the cupola with the preheated blast.

TABLE I.—*Operation Table for 54 in. i.d. Cupola, with a Fixed Blast Rate of 5,200 cub. ft. per min.*

Iron to coke ratio.	Lb. of coke per ton of melt.	Melting rate, tons per hour.	Metal temp., deg. C.	Cost of coke at $24·00 N.T.	Approx. thermal efficiency, per cent.
12 to 1	187	14.3	1,460	$2·00	46.7
11 to 1	204	13.6	1,466	$2.18	43.0
10 to 1	224	12.7	1,475	$2.40	39.5
9 to 1	249	11.7	1,485	$2.66	36.0
8 to 1	280	10.7	1,500	$3.00	32.0
7 to 1	321	9.7	1,520	$3.43	28.4
6 to 1	373	8.8	1,535	$4.00	27.0

REFERENCES

[1] A. W. Belden, *Bulletin* No 54, US Bureau of Mines (Abstracted by H. W. Lownie, Jr., "Review of Foundry-Cupola Gases and Temperatures," Whiting Corp., *Bulletin FO*-9).
[2] Sam F. Carter and R. Carlson, "Some Variables in Acid Cupola Melting," A.F.S. *Trans.*, 1954.
[3] W. W. Levi, "Desulphurizing Cupola Cast Iron from the Practical Operating Angle," A.F.S. *Trans.*, 1940.
[4] D. J. Reese, "Cupola Operation," A.F.A. *Trans.*, 1938.
[5] Sam F. Carter and R. Carlson, "Acid Cupola Slags and Some Relationship with Melting Conditions," A.F.S. *Trans.*, 1953.
[6] W. W. Levi, "Operation of the Cupola," A.F.S. *Trans.*, 1950.
[7] S. W. Healy, "Cupola Operation with Heated Blast," *American Foundrymen*, March, 1948; also "Hot Blast—for Better Melt, Closer Control and Greater Economy," Whiting Corp., *Bulletin FO*-3.
[8] S. A. Herres and C. H. Lorig, "Cupola Blast Control," Whiting Corp., *Bulletin FO*-7.
[9] C. Morrison, "Cupola-Electric Furnace Duplexing of Malleable Iron," A.F.A. *Trans.*, 1943.
[10] S. C. Massari and R. W. Lindsay, "Melting in the Cupola," A.F.A. *Trans.*, 1941.
[11] C. F. Joseph, "Measuring and Controlling Pouring Temperature and Fluidity," A.F.A. *Trans.*, 1936.

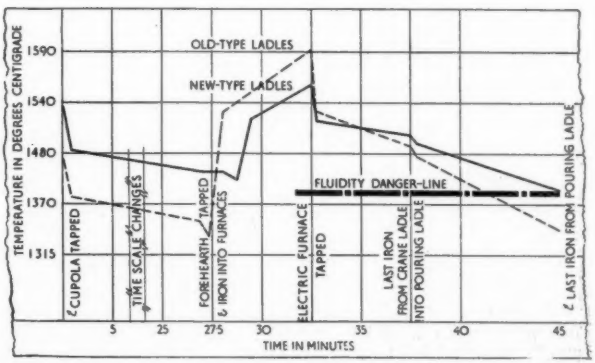


FIG. 11.—*Time/temperature record of a cupola melt, including a period of superheating in the electric furnace—from Carl F. Joseph.*

International Foundry Congress

Arrangements Concluded for the Dusseldorf Meetings, Exhibitions and Tours

This year's International Foundry Congress, a very important event in the foundry world, is to be held in Düsseldorf, Germany, from September 1 to 9. It is being attended by delegates from all over the world, for apart from the very extensive programme of lectures, works visits and social events, a full-scale foundry and foundry equipment exhibition is being staged. The British delegation will be of the order of 120, lead by the president of the Institute of British Foundrymen, Mr. H. J. V. Williams, and Dr. A. B. Everest, the vice-president of the International Committee of Foundry Technical Associations. In order to help visitors, a map showing the location of the various meeting places is reproduced in Fig. 1.

Exhibition

On a permanent exhibition site along the banks of the Rhine, nearly half-a-million sq. ft. of space will be utilized to show all that is new in foundry equipment, materials and foundry products—the first time such an exhibition has been held for 20 years. Separate sections will be devoted to the history and literature of founding, casting defects, noise abatement, recruitment of labour and other matters of special and topical interest.

If one excepts UK firms having German associates, so far as is known at present, only two British firms will be exhibiting, namely, British Moulding Machine Company, Limited, and Foundry Equipment, Limited. The former firm will be showing on stand No. 137, Hall "M" one of their new, type BQ, machines, exhibited for the first time at the recent Engineering and Marine Exhibition, Olympia, but with the difference that this model will be automatically operated. A particular feature of type BQ machines is that even with the manually-operated version, the operator does not have to lift either the empty flask or the finished mould. This is because the boxes are rolled up to and on to the machine and moulds roll off the other side on the flanged rollers which are an integral part of the machine. The automatic-operating valve is of an entirely new type involving neither electronics, nor even simple electrics, nor does it depend on "time sequences" for its operation. Another feature is that the machine can at any time be manually operated (when making trial moulds for example) without having to make even the most minor adjustment to valve or machine. These BQ machines are available in two sizes and the one at Düsseldorf will be capable of making moulds 25 by 21 by 7 in. in from 15 to 60 sec.

At the same exhibition Foundry Equipment, Limited, will occupy stand No. 410/427 in Hall N1, and expect to show the following equipment:—The HEB1 "boxless" moulding machine and SP10 "de luxe" shell-moulding machine; a "Junior" model Sandrammer complete with feed unit and skip loader; a BMO sand mill; a segmented wire-rope bucket-elevator structure and twin hoppers with pneumatic gates, feeding two JPM1 automatic jolt/squeeze moulding machines; a length of the firm's latest type of roller-conveyor track and a FE-Matic vibratory knock-out.

A staff of operators and demonstrators will be in attendance from both these companies during the whole period of the exhibition.

Lecture Programme

In addition to the usual technical sessions at which domestic and foreign papers are presented and discussed, there is to be a symposium on "Design and Castings." This is purely a German effort (with the exception of one Swiss contribution), and is to be held on Monday, September 3. It opens with a lecture on the advantages of castings for the building industry, followed by four lectures on recent developments of cast materials and the possibility of their treatment,

(*Continued on page 57, col. 2*)

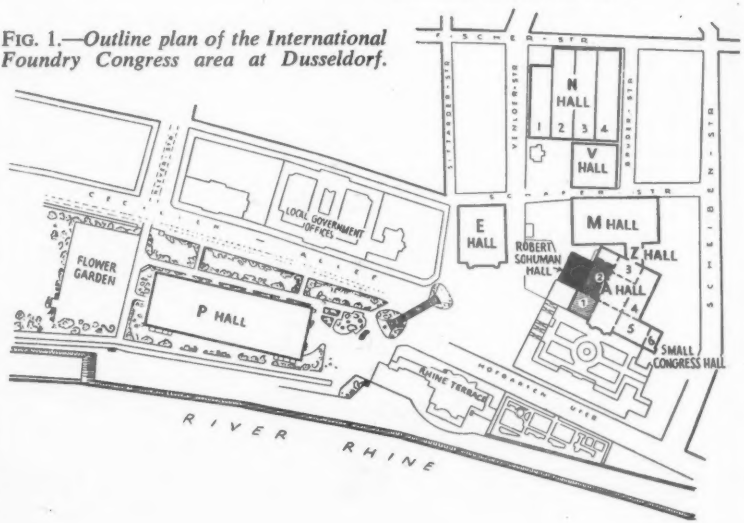


FIG. 1.—*Outline plan of the International Foundry Congress area at Dusseldorf.*

Key: Lecture Room 1: Robert Schumann Hall; Lecture Room 2—*Hall A2*; *Hall A1*: Information Office GIFA service; *Hall A3*: Exhibition of foundry plant layout and special exhibition of work organization; *Hall A4*: Scientific and historical exhibition; *Hall A5*: Display of literature pertaining to foundry practice; *Hall A6*: Exhibition cinema; *Hall M and Z*: Sand preparation plant, moulding and fettling machines, and coreblowers; *Hall V*: Workmen's safety appliances; foundry hygiene; welding and burning equipment; testing machines; measuring, control and registering instruments; laboratory equipment; and raw materials; *Hall N*: Exhibition of melting and heat-treatment furnaces, moulding boxes and foundry supplies. Special educational exhibitions; noise and dust control; *Hall E*: Non-ferrous castings exhibition and machines for gravity-die, pressure-die, and centrifugal casting. *Hall P*: Exhibition of castings in iron, steel and malleable; Special "Design and Casting" exhibit.

Latest Developments in Spheroidal-graphite Iron*

London Discussion of Mr. W. W. Braidwood's Paper

A thoroughly practical discussion followed the presentation of this Paper at a meeting of the London branch of the Institute of British Foundrymen, and what follow are extracts from the comments recorded. Topics included heat-treatment, lack of section sensitivity of the material, welding, "snags" arising during production, alternative melting methods, feeding and annealing characteristics and a note on the employment of the sealed treatment-ladle.

Before the discussion on the Paper, "Latest Developments in Spheroidal-graphite Iron" given by Mr. W. W. Braidwood to the London branch of the Institute of British Foundrymen, there was an interval during which the members were able to inspect sample castings and demonstrations of properties of the metal, which had been arranged in the lecture hall.

MR. P. A. RUSSELL opened the discussion and said that Mr. Braidwood had covered the subject very fully and had not left much that could be added, but he had one criticism; it was of the title to the film—"Cast Iron that Bends"—which had been shown. He would have liked the title to have been altered to "Cast Iron that can be Bent." Spheroidal-graphite iron had very few uses where it was bent, the point was that it could bend rather than break.

Heat-treatment

On the subject of heat-treatment, it should be noted, he said, that s-g iron could not be carburized or pack hardened because the carbon was already in the material. However, it was an ideal material for flame hardening. Mr. Russell here showed a gear-wheel (Fig. A) which was a component part of a drilling machine. It was normally used in the fully-annealed condition but that was not always hard enough, so one could be taken from stock, flame hardened and then became a "super" wheel. That indicated the flexibility of the material. There were many applications which included flame hardening and induction hardening of s-g iron.

Mr. Russell next showed a second illustration (Fig. B) which was of great interest to iron founders; it showed a very small casting and quite large ones all of which were cast from exactly the same metal. Both types of castings were given the same heat-treatment and there were none of the worries about controlling composition according to section thickness that the founder of the ordinary grey-iron had to contend with. As-cast, the small piece might be white in fracture, but the simple heat-treatment produced the same range of properties as were found in the larger castings.

MR. W. W. BRAIDWOOD agreed with Mr. Russell's views: in the past, too much emphasis had been laid on the ductility which could be developed and the impression had probably been given that s-g iron could always be bent, twisted or stretched quite readily, whereas, in fact, it had high yield-strength and a modulus of elasticity and could be made very hard when so desired.

Welding

MR. E. HARWOOD BROWN said Mr. Braidwood's Paper had brought to the fore things which most of them had heard about and represented a proper collation of facts. In some examples which had been shown a certain amount of welding had been used, and he would like to know what type of welding rod had been employed for that work.

MR. BRAIDWOOD said when s-g iron was welded electrically, the best electrode to use was a proprietary nickel/iron alloy made in America but also marketed in this country. (He offered to give the enquirer details of this privately if required.) Where welding was effected by the oxy-acetylene flame, use was made of filler rods of s-g iron and pre-heating was necessary. A paper by Ball and Thornycroft* given at the Glasgow Conference of the Institute had described the process and the results.

Possible Snags

MR. B. JONES congratulated the lecturer on the completeness of the Paper. His own immediate reaction was to change to s-g iron immediately and he thought that many others would feel the same.

The advantages of this metal "stood out a mile" but obviously there were snags. Could Mr. Braidwood give some idea of the sort of difficulties which a beginner should look out for? Forewarned was always forearmed.

MR. BRAIDWOOD said that a full answer to that question would require another long lecture. The producer of s-g iron had his troubles and his bad castings, as had the founders of all other metals. The main handicap in the early days was the fact that any defect, whatever its nature or true cause, was liable to be blamed on the new iron and to be peculiar to the material. There was still a number of producers licensed several years ago who still used the acid cupola for melting and who were liable to have more than a normal share of trouble. On the other hand, the producer who installed more suitable equipment had a much happier time, as he deserved to have. It was of primary importance that there should be enough residual magnesium in the metal, insufficiency would cause imperfect structure and properties. A second hazard was the possible presence of incidental elements of troublesome type, Some were elements never

* Paper printed in the JOURNAL, May 17 issue.

* JOURNAL, October 28 and November 4, 1954.

FIG. A.—*S-g iron gear wheel shown by Mr. P. A. Russell, which can be flame-hardened to give superlative qualities in service; previously it was used in the fully-annealed condition.*

really looked for in ordinary cast iron and in proportions hardly detectable unless by special techniques which had been developed. Lead, for example, if present to the extent of 0.002 per cent. was quite enough to cause deterioration in graphite form. However, that sort of trouble had been overcome. Excellent co-operation from many producers of pig-irons, who had been quick to realize the potentialities of s-g iron, had resulted in special grades of pig-iron being made for the purpose. An increasing number of producers, however, used synthetic iron made from structural steel scrap and carbon. In that steel scrap there were no interfering elements, and such scrap was cheap in Britain and many other countries, and generally available in sufficient amounts. Licensees and prospective licensees were recommended to provide suitable furnaces which could use heavy proportions of steel scrap along with technical and economical advantage.

Molten spheroidal-graphite iron had a tendency to dross formation due to the presence of magnesium oxide. The solubility of magnesium in iron was low and its affinity for oxygen high. However, when the melting arrangements were suitable and all operations well controlled, there was no outstanding difficulty in making even the most exacting types of castings.

Melting Methods

MR. B. LEVY asked if he was to understand that it was impractical to melt s.-g. iron in the cupola and would that put it out of range of the small foundry which was not prepared to instal electric melting equipment? Also, he believed that Mr. Braidwood had mentioned a pouring temperature of 1,150 deg. C., which seemed extraordinarily low.

MR. BRAIDWOOD interrupted to make it clear that the temperature quoted was that of the solidification of s-g iron.

Continuing, MR. LEVY asked what was a good pouring temperature for s-g iron and could any ordinary furnace attain the temperature named? He had had one or two comments from users of s-g iron and they complained of cavitation, which seemed to indicate that the iron was prone to initial liquid shrinking and therefore seemed to require a lot of extra feeding over and above that of ordinary high-duty irons. Finally, could Mr. Braidwood give members some indication of the type of furnace that he would recommend for the successful operation of s-g iron?

MR. BRAIDWOOD said that when s-g iron was first produced, he was among those who then said that an advantage of the material was that it could be made in any furnace. From his experience since that time, he would now say that it would have been better if it had been found that the ordinary cupola could not be used for this purpose. That would have saved a lot of trouble, especially in the early stages. However, it was a fact that the ordinary cupola *could be used* and in many cases *was used* just because it was already available but, where the production procedure was to have maximum reliability with minimum loss of temperature, a more suitable melting unit was essential. The answer to Mr. Levy's question on the type of furnace to be preferred depended on conditions. In this country, the main argument in favour of the ordinary cupola was not only that foundries usually possessed such a furnace already, but that coke was still available here of better quality and lower cost than that obtainable in some other countries. In Scandinavia, for example, the position was much different, in that every iron foundry did not possess a cupola but nearly every one had an electric furnace—coal was expensive while electric power was cheap. The making of s-g iron there was an easy matter because their existing equipment was usually very suitable.

As to what type of furnace was best, usually there was a real advantage in the use of an electric

FIG. B.—*Large and tiny castings produced from s-g iron of the same composition, indicating the lack of section sensitivity of the material.*

furnace which should preferably be of simple design, and one easily operated in any iron foundry where there was no previous experience of electric melting. The type of electric furnace now in widest use in Europe for this purpose was the coreless, normal-frequency type, now being made in this country and which seemed certain rapidly to become familiar to British foundrymen.

Founding Properties

Mr. Levy had also asked what was a good pouring temperature; the answer was that it should be the highest possible. With suitable equipment and technique, it was quite practicable to carry out the process of making spheroidal-graphite iron and have the fully-treated metal available for pouring of moulds at temperatures above 1,400 deg. C. One foundry in Scandinavia always began to pour at 1,470 deg. C. and never seemed to have any particular trouble. An advantage of s-g iron was the fact that atmospheric feeders could be used effectively. That was an aid to tranquil pouring, because the metal could be gated through atmospheric feeders positioned low in the mould. Moreover, since s-g iron showed "sinks" at insufficiently-fed sections, a first-off casting had only to be cleaned and its surface examined to determine where extra or modified feeding would be needed, if any. A good s-g iron foundry should be regularly achieving a yield of saleable castings amounting to 50 to 60 per cent. of the molten metal poured.

MR. RUSSELL said he thought Mr. Braidwood was inclined to exaggerate the importance of high pouring-temperatures. It was a remarkable property of s-g iron that it seemed to have a much greater fluidity range than a corresponding grey iron; with s-g iron, the metal would run until it almost set in the ladle. There were, he admitted, certain troubles traceable to the use of unduly "dull" iron and such low casting temperatures should not be employed.

Return Scrap

MR. LEVY asked about the re-use of s-g iron scrap; were there any difficulties in doing so?

MR. BRAIDWOOD said most licensees used all their return scrap within charges. They did not get any benefit from the magnesium which was completely lost on remelting. Where treatment was effected by the use of nickel/magnesium alloy, the nickel content would build up to some extent, usually to around 2 per cent. in the foundry using the ordinary cupolas and a lower figure when other means of melting were employed. One method of operation was to divide the s-g irons produced into two groups; the ductile grade in which the nickel content should be kept low, and the harder and stronger grade in which a higher nickel content was an advantage. In such foundries, the nickel-containing s-g iron scrap was used mainly in the charges for the second type.

Annealing

MR. WASH asked what was the average heat-treatment given to produce the ductile type of spheroidal-graphite iron?

MR. BRAIDWOOD said that the normal annealing cycle involved heating to the range of 850 to 900 deg. C. and holding at that temperature for a period between one and, at the most, six hours. Then there was a choice of two alternatives—the castings could be allowed to cool slowly through the critical range or they could be cooled to just below the transformation temperature and held for a sufficient time (usually 6 to 8 hours). Section thickness did not matter very much. In a mixed lot of castings there might be thin castings which were completely white in fracture, but the carbide broke down very readily.

Sealed Ladle

MR. M. A. TOTHAM asked if Mr. Braidwood could clear up a practical point regarding the sealed ladle. It appeared that the ladle had to be discharged through the small aperture in the centre of the iron cover through which the plunger entered. The shape of this aperture would have to be preserved or it would not fit the sealing flange at the top of the plunger. How was the periphery of the aperture protected from the molten metal flowing over it?

In reply, Mr. Braidwood first referred again to Fig. 1 and explained that there were two methods of discharge. When the treatment was finished and the plunger removed, one could pour directly through the central aperture in the cover or one could knock out the three wedges securing the cover and then remove it, before discharging over the side of the ladle. The first method was the more convenient and the s-g iron face of the cover over which the metal flowed could be quite effectively protected by precoating it with blackwash and placing ganister on top. Castings were rarely, if ever, poured directly from a sealed ladle and the discharge was therefore quickly made into a pouring ladle.

Vote of Thanks

MR. JOHN GARDOM proposed a vote of thanks to the lecturer and said it was a great privilege for him to do this and he took it, the honour had been conferred because of his long connection with the London branch. All must be very pleased with the lecture but perhaps all could not agree with the name for the material. Why it should be called spheroidal-graphite iron, he did not know. Everyone "bungled" the word "spheroids" but it appeared to be capable of a fairly simple translation. The lecture had been a most interesting one because Mr. Braidwood was an authority and had gone into his subject thoroughly. He had presented much basic fact and while preparing the Paper had made constant use of references and data. As a result, his lecture had been well arranged, coherent and interesting.

Mr. Gardom then asked if Mr. Braidwood could take the matter a little further and tell founders where they were going next. Could they get a constant supply of s-g iron from any furnace so that they could arrange continuous pouring of moulds and so realize the dream of the future—a

Spheroidal-graphite Iron—Discussion.

mechanized and continuous-running foundry?

MR. LEVY, who seconded the vote of thanks, said that Mr. Braidwood's lecture showed the kind of thing the iron foundry had to face up to, namely, a demand from engineers for ever-higher performance from the materials employed in cast form. It was only by serious consideration of subject matter such as that which Mr. Braidwood had so skilfully put before members that evening, that they could continue to be a progressive industry. He wholeheartedly endorsed the vote of thanks which had been proposed. (The resolution was carried by a hearty round of applause.)

MR. BRAIDWOOD, acknowledging members' thanks, said the ideal still to be realized was indeed that of continuous tapping of fully-treated iron ready for direct pouring into moulds—that was one of the aims very much in the minds of all who were constantly striving to develop s-g iron. There were several lines of approach being followed and one day, success under that heading might be reported. It had given much pleasure to prepare and present the Paper, which constituted his only public "progress report" since 1953.

Influence of Mould Variables and Inhibitors on Mould Reaction in Aluminium/10 per cent. Magnesium Alloy

Miss Marjorie Whitaker, B.Sc., a research investigator at the British Non-Ferrous Metals Research Association, has summarized her conclusions and recommendations in a paper—Influence of Mould Variables and Inhibitors on Mould Reaction in Aluminium/10 per cent. Magnesium Alloy—presented to the Institute of Metals, in the following statement:—

It was concluded that the extent of mould reaction in the 10 per cent. magnesium alloy is influenced by mould variables such as ramming density, moisture content, and coarseness of the sand, by reason of the variation in the chilling power of the mould. The soundest castings are obtained by using medium or fine sand and ramming as hard as is consistent with adequate permeability and other desirable characteristics. In 2-in. dia. castings, the porosity due to mould reaction was proportional to the square of the time of solidification. Ammonium bifluoride addition to the sand is more effective than boric acid in reducing mould reaction in this alloy, but its use requires a well-ventilated foundry.

The paper terminates a long programme of research on mould reaction in aluminium/10 per cent. magnesium sand castings, which leads to the following recommendations:

(1) An addition of 0.004 per cent. beryllium should be made to the metal. There is no advantage in adding more beryllium in the range up to 0.1 per cent.

(2) Contamination of the melt with sodium should be avoided. Grain refiners are harmless.

(3) Coarse sand should not be used and moulds should be rammed as hard as is consistent with adequate permeability and other necessary characteristics of the mould. This is particularly important when inhibition is incomplete.

TABLE I.—*Sand Inhibitors for Use with Aluminium/10 per cent. Magnesium Alloy Containing 0·004 per cent. Beryllium.*

Section thickness, in.		Mould treatment for:	
Cylindrical.	Plate.	Complete inhibition.	Inhibition where 2 per cent. porosity in outer part of casting is acceptable.
1	Up to ½	Mix 1 per cent. boric acid or 1 per cent. ammonium bifluoride with the sand, or coat mould with either.	Plain sand.
1–2	½–¾	Mix 2 per cent. boric acid or 1 per cent. ammonium bifluoride with the sand, or coat mould with either.	Mix 1 per cent. boric acid or ammonium bifluoride with the sand or coat mould with either.
2–3	¾–1	Mix 2 per cent. boric acid or 2 per cent. ammonium bifluoride with the sand, or coat mould with ammonium bifluoride.	As above.
3–4	1–1½	Mix 6 per cent. ammonium bifluoride with the sand.	Mix 2 per cent. boric acid or 2 per cent. ammonium bifluoride with the sand, or coat mould with ammonium bifluoride.
4–5	1½–2	Mix 6 per cent. ammonium bifluoride with the sand, and insert chills to hasten solidification and improve feeding.	Mix 6 per cent. ammonium bifluoride with the sand.

(4) Pouring temperature should be as low as is consistent with good foundry practice.

(5) Inhibitors should be added to the sand as indicated in Table I, the metal being assumed to contain 0.004 per cent. beryllium. The recommendations are based on the freezing rate of the casting which, for simple castings, is related to the section thickness. Complex castings with many internal members, *e.g.*, cylinder blocks, cool more slowly than the rate corresponding to the section of the members, and allowance should be made for this. As a small amount of mould reaction is acceptable in many commercial castings, two columns are given in Table I, one containing recommendations for complete inhibition and the other for sufficient inhibition to keep the sub-surface porosity below 2 per cent.

George Cohen Reorganization

Steps to simplify group administration and control are announced by the directors of George Cohen Sons & Company, Limited, which is increasing its dividend for 1955-56 by 2 per cent., equivalent to 11 per cent. If the move is approved, the name of the present parent company will be changed to the George Cohen 600 Group, Limited (or such name as may be approved by the Board of Trade).

A new subsidiary will take over the trading activities of the parent, and adopt the name of the latter—that is, George Cohen Sons & Company. The renamed parent will thus become solely a holding company.

Group profits in the year to March 31, 1956, increased by about £440,000 to £1,856,808.

INTERNATIONAL COMBUSTION, LIMITED, of Derby, are holding a "Parents' Day" on August 18.

Influence of Rate of Solidification on the Mechanical Properties of Cu/Sn/Zn and Cu/Sn/P Alloys*

By P. J. Le Thomas and D. Arnaud

The factors determining the mechanical properties of any given point in a tin-bronze casting are: the amount of the δ-constituent present and the grain size at this point. A relationship exists between grain size and percentage of δ-phase, for a given Sn content, but this is valid only for known depths from the surface of the casting. Since all these variables (which reflect in fact the conditions of solidification) are related, it may be accepted that a necessary correlation exists between the strength properties of sectioned specimens removed from any castings in the same bronze. The above analysis assumes, of course, that the castings are free from defects, for example those due to gases. It also assumes that fracture is transcrystalline, that is, that the tensile test is indicative of the strength of the actual crystals and not that of the boundaries.

MR. PIERRE JULIEN LE THOMAS was born in 1924, and studied at *l'École Nationale Superieure de Chimie* in Paris. In 1948, he took up an appointment with the *Centre Technique des Industries de la Fonderie* in Paris, where he was engaged on investigations on copper alloys. He was then put in charge of the central laboratory in Sevres, and during 1954 he became chief of the copper alloy division. In this capacity he is in charge of research work on copper alloys and of liaison with industry in this field. MR. D. ARNAUD is also engaged at the *Centre Technique* as assistant in the copper alloys division.

Introduction

Every foundryman knows that the mechanical properties of a bronze casting (even one that is completely sound), depend on the position from which the sectioned test-piece is taken. The Association of Bronze and Brass Founders[1] carried out in 1948 a very useful investigation of this question, with general reference to the copper-base alloys, but with more particular attention to the tin-bronzes. Similarly, numerous papers have appeared in the last 20 years on attempts to determine the "best" shape of cast specimen for taking tensile specimens, or to establish an empirical relationship between the properties determined on the various cast specimens used. The work of the International Organization for Standardization lends topical interest to this problem, which must be initially approached by considerations relative to the actual structure of the alloys.

In this connection, one of the present Authors has shown[2] that it is possible, by means of dilatometric analysis, to demonstrate the local occurrence of the δ-phase in bronzes containing about 10 per cent. tin. The tensile properties, for corresponding grain sizes, depend on the amount of this constituent present. The tensile strengths are, broadly, proportional to the amount of δ-constituent for a bronze containing at least 0.15 per cent. phosphorus, and inversely proportional for a non-phosphorus bronze. An attempt is made in the present work to state these ideas precisely, with particular attention to the mechanism of fracture in tin-bronzes under ordinary tensile conditions.

* Official Exchange Paper from the *Association Technique de Fonderie*, presented at the annual conference of the Institute of British Foundrymen in Cardiff in June.

Experimental Method

The test casting used was the cruciform standard French test-piece used for preparing tensile specimens of 75 sq. mm. section. It was horizontally poured, simultaneously in sand and metal moulds (Fig. 1). The composition of the materials studied are given in Table I.

For the tensile tests, bars shown as A, B, C, in Fig. 1 were cut in each case, *i.e.*, two bars cast in sand and one in a chill mould. The lateral bars were used in various auxiliary tests. All the melts were carried out in a small 8-kg. (17.5 lb.) capacity crucible furnace fired with propane, the charges consisting of 100 per cent. virgin metal. Any unsound specimens were rejected. To prevent slag from entering the moulds, a bottom-pouring ladle was used. Pouring was at 150 deg. C. above the liquidus of the alloys studied, a temperature sufficiently low to give as far as possible non-columnar structures.

Mechanical Properties

Tables II to VI summarize the tensile properties obtained for each of the test bars, A, B, C. The chill-cast specimens give the best results, and apparently show the least scatter, but the variation in properties for different tin contents is such that any attempt to make direct use of the results of the tests must be abandoned, even where these

are as comparative as possible. To facilitate comparison, therefore, the true tensile stress, R′, has been given throughout, *i.e.*, the true stress undergone by the test-piece at the moment of fracture in relation to the cross-sectional area at fracture. However, even after this correction, values are very scattered.

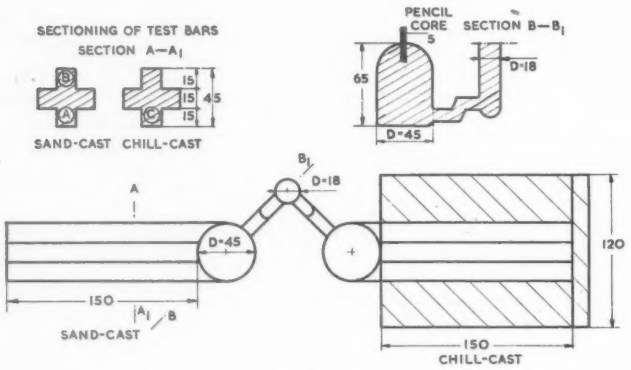


FIG. 1.—*Pouring arrangement of test specimens (dimensions in mm).*

TABLE I.—*Composition of the Alloys Studied.*

Alloy.	Copper.	Tin,* per cent.	Zinc, per cent.	Phosphorus, per cent.
1. Binary bronze ..	Remainder	5–12	—	—
2. Ternary bronze, with 2 per cent. zinc	Remainder	5–12	2	—
3. Ternary bronze, with 4 per cent. zinc	Remainder	5–12	4	—
4. Ternary bronze, with 0.15 per cent. phosphorus	Remainder	5–12	—	0.15
5. Ternary bronze, with 0.30 per cent. phosphorus	Remainder	5–12	—	0.30

* In increments of 1 per cent.

Macrographic Examination

As expected, the low casting temperature gave equiaxed (non-oriented) structures, except, however, in the case of certain bronzes containing 2 per cent. zinc—or purely binary alloys—which gave marked columnar structures both when sand-cast and chill-cast (Figs. 2 and 3). This fact must be regarded in the light of the difficulty experienced, under the conditions of test, in completely filling the mould when pouring the phosphorus-free bronzes, the metal "running badly." This agrees with the assumption that the phosphor-bronzes remain sufficiently fluid, even after solidification has begun, for the crystallites formed to be stirred up by the thermal action and distributed throughout the liquid phase up to the moment of complete solidification. On the other hand, when the liquid alloy is not fluid, the nuclei formed in contact with the walls of the mould adhere thereto, and crystallization proceeds preferentially from these points. Although the study of columnar structures does not come within the scope of the present work, it is of interest to note this fact, which tends to show that for given conditions of solidification, the viscosity of the liquid phase exerts a significant influence on the shape of crystals obtained.

Grain sizes were measured at 3-mm. and 15-mm. from the surface, these being the depths at which

FIG. 2 (LEFT).—*Columnar structure, chill-cast; and* FIG. 3.—*Columnar structure, sand-cast. Both* × *5 mag.*

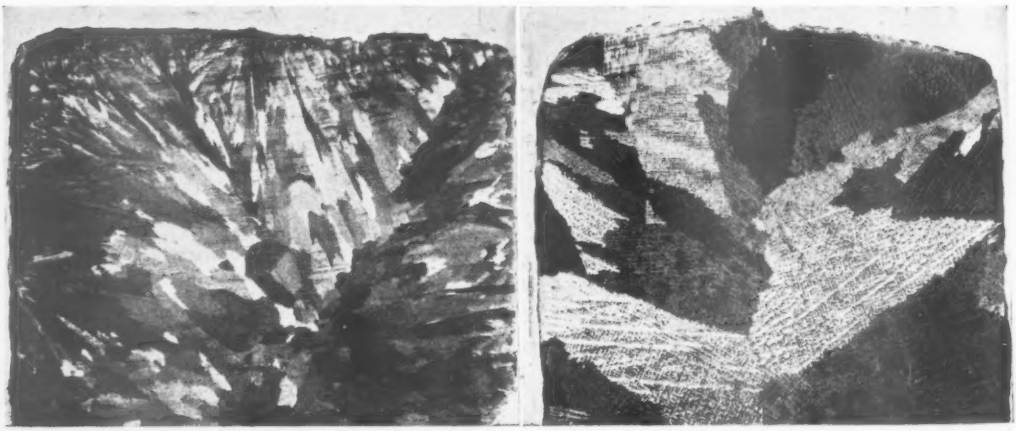


TABLE II.—*Binary Bronzes.*

Specimens.		Mechanical Properties.			
Sn, per cent.	Designation.	Tensile Strength tons per sq. in.	Yield Point tons per sq. in.	Elongation, per cent. on 2¾ in.*	Reduction of area, per cent.
5	A	18.7	8.3	34.2	32.0
	B	19.5	8.7	40.8	40.0
	C	21.0	9.5	51.1	64.0
6	A	19.4	9.1	39.2	40.0
	B	18.4	8.2	30.0	44.0
	C	21.1	9.4	51.1	50.0
7	A	19.7	9.4	39.4	35.0
	B	18.6	9.2	31.6	26.0
	C	21.4	10.1	34.9	28.0
8	A	20.1	10.7	37.5	34.0
	B	20.1	10.7	37.7	44.0
	C	23.2	11.0	42.6	36.0
9	A	19.6	10.2	29.2	28.5
	B	20.6	10.6	34.6	35.5
	C	21.9	11.9	19.1	22.5
10	A	20.5	10.9	29.2	26.5
	B	21.0	11.2	32.6	33.0
	C	25.0	11.9	26.6	24.0
11	A	20.8	11.8	22.3	18.6
	B	21.4	10.2	22.9	17.0
	C	23.4	13.7	10.5	5.2
12	A	17.5	11.9	9.4	8.0
	B	19.2	11.2	12.9	12.0
	C	22.9	15.7	6.9	5.0

* The physical test results recorded in Tables II to VI were carried out on test-bars of 9.8-mm. dia. (75 sq. mm. cross-section) and the percentage elongations were calculated on a gauge length of 70 mm. (2¾ in.). Thus, generally, these values are lower than would be recorded in the UK using a 2-in. gauge length.

the dilatometric specimens were cut, lengthways. It will be remembered that these were used to determine the amount of δ-constituent present by measuring the expansion on heating due to the transformation $\alpha+\gamma \rightarrow \beta$.

TABLE III.—*Ternary Bronzes* (*2 per cent. Zinc*).

Specimens.		Mechanical properties.			
Sn, per cent.	Designation.	Tensile Strength tons per sq. in.	Yield Point tons per sq. in.	Elongation, per cent. on 2¾ in.	Reduction of area, per cent.
5	A	14.9	7.7	24.5	28.0
	B	15.8	8.5	26.8	24.0
	C	20.9	10.5	55.0	52.0
6	A	19.9	9.5	35.2	33.0
	B	21.5	9.9	51.7	44.0
	C	22.9	10.2	52.5	54.0
7	A	17.0	8.6	31.5	30.5
	B	19.6	8.9	51.7	40.0
	C	23.2	10.9	49.7	50.0
8	A	21.5	9.3	36.6	33.0
	B	21.5	9.3	37.1	35.0
	C	23.5	11.2	44.7	52.0
9	A	20.0	9.5	34.9	28.0
	B	21.1	9.9	36.8	34.0
	C	25.5	12.1	34.2	24.0
10	A	18.2	9.2	21.7	22.5
	B	21.2	10.4	32.0	29.0
	C	25.6	14.3	22.6	17.4
11	A	17.8	9.5	17.0	16.5
	B	18.0	9.7	18.3	19.0
	C	25.7	13.0	17.4	14.8
12	A	17.3	10.9	8.6	5.4
	B	19.0	11.4	12.0	8.0
	C	22.2	16.2	4.8	4.0

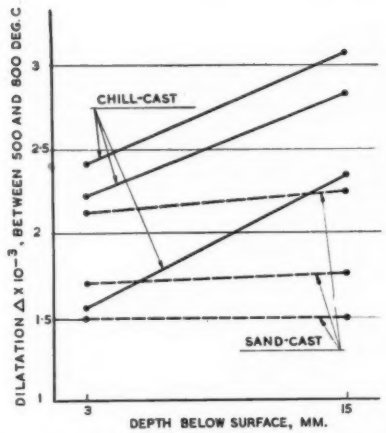


FIG. 4.—*Segregation of δ-phase at inner sections.*

Fig. 4 establishes the following points:—(a) more of the δ-constituent was present in the chill-cast specimens (undercooling); (b) under the conditions of test, there was no inverse segregation; (c) normal segregation is much more marked in the case of the chill-cast specimens; and (d) it is substantially of the same order for all the alloys studied, and thus depends, at any rate for the conditions of test, entirely on the manner of solidification.

Fig. 5 clearly indicates the relationship between grain size and the δ-constituent at a given depth below the surface. It will be noted that for the chill-cast specimens there is a noticeable increase in the amount of δ at a depth of 15-mm., without

FIG. 5.—*Variation of grain size with δ-phase at the surface and inner section* (*cruciform test-piece, bronze* 90/8/2).

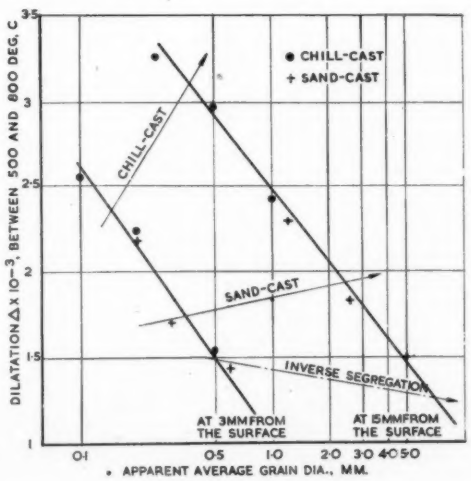


TABLE IV.—*Ternary Bronzes (4 per cent. Zinc).*

Specimens.		Mechanical properties.			
Sn, per cent.	Designation	Tensile Strength tons per sq. in.	Yield Point tons per sq. in.	Elongation, per cent. on 2¾ in.	Reduction of area, per cent.
5	A	17.3	8.1	37.1	29.5
	B	17.8	8.2	36.5	31.2
	C	21.0	8.9	48.6	44.0
6	A	18.7	8.5	40 0	35 0
	B	19.7	8.7	50 6	38.5
	C	22.5	10.7	50.9	48.0
7	A	20.7	9.4	43.1	33.0
	B	20.7	9.1	44.8	33.5
	C	23.9	11.0	46.0	34 5
8	A	21.1	9.5	29.5	28 0
	B	22.9	10.1	47.1	35.5
	C	24.2	10.2	28.0	12.0
9	A	20.0	10.5	22.9	16.5
	B	20.7	11.4	24.0	19.0
	C	24.8	12.7	17.0	14.0
10	A	18.8	11.4	11.1	10.0
	B	19.3	11.5	12.6	10.0
	C	22.7	16.3	5.1	8.0
11	A	17.9	12.9	7.0	5.5
	B	18.8	13.0	9.0	8.2
	C	23.7	16.3	5.4	5.5
12	A	16.8	10.5	5.5	4.0
	B	18.4	11.3	6.2	3.8
	C	20.3	14.3	2.4	2.5

a marked increase in grain size. On the other hand, the sand-cast specimens show an increase in grain size and a very slight increase of δ. A knowledge of the grain size immediately adjacent to the surface should, therefore, make it possible to learn, without a destructive test, between what limits the grain size and content of δ-constituent will fall at any given depth.

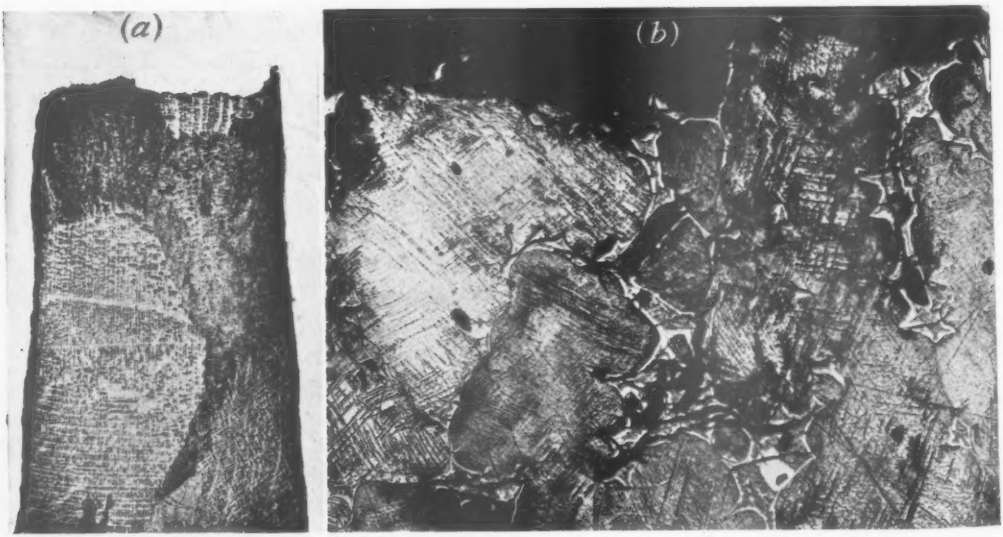
Strictly speaking, these limits are defined by the two parallel lines in the graph, which start from the point representing the grain size at the surface. The method of solidification (sand- or chill-cast) is, in fact, the determining factor, so that the two properties can be determined with reasonable accuracy. When broadly applying the graph, Fig. 5, to castings of given section, it may possibly suffice to express distance from the surface as a percentage of the half-section of a particular casting, but no definite ruling can at present be given on this question.

In principle, there is an increase in grain size and in δ-constituent from the surface to the inner sections of the casting. It is possible, however, *a priori* to conceive a case where there is less δ at the inner sections than at the surface, *i.e.* inverse segregation. The slope of the arrowed lines, indicating solidification, show that inverse segregation is a characteristic of very slow rates of cooling. The temperature and speed of pouring are clearly the factors determining grain size and the δ-phase constituent at the surface

Micrographic Examination

Metals which are wrought and annealed and consisting of a solid solution, when subjected to a tensile test, normally fracture across the grains, because the joint is stronger than the actual crystals. If intercrystalline fracture occurs, it is because of abnormal weakness at the grain boundaries, usually due to the deposition of weakly soluble impurities or oxides at the boundaries. Premature fracture then occurs and mediocre properties result. The elasticity of polycrystalline materials, moreover, increases with fineness of grain.

FIG. 6.—*Transcrystalline fracture (a) (× 5) and (b) showing evidence of fracture associated with δ-phase (× 250).*



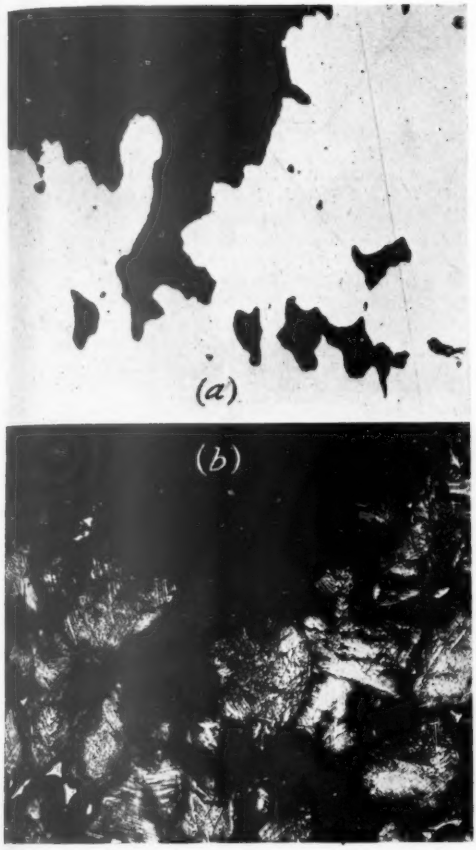


FIG. 7.—(*a*) *Intercrystalline fracture* (*unetched*, × 100) *and* (*b*) *appearance of intergranular fissures in the same section* (*etched*, × 100).

The same principles apply to cast bronze. Micrographic examinations were made, on the axial plane, of the area of fracture in the majority of the tensile specimens in this investigation. When the fracture is transcrystalline, the edge is fairly straight and there is no loosening behind the fracture. When it is intercrystalline, deep tearing occurs and if the specimen has undergone elongation, cavities, due neither to blowholes nor to microporosity, occur at the grain boundaries adjacent to the fracture. A third type of fracture, peculiar to bronzes, may be found when the δ-phase occurs as a continous network; the line of fracture then follows the δ-network. Figs 6 to 9 illustrate these points and show them in diagrammatic form.

Prior fracture of the [δ] constituent inclusions must necessarily occur in cases where slipping cannot take place, either at the α/α boundaries or the α/δ boundaries: the constituent with the highest modulus (δ) absorbs the major proportion

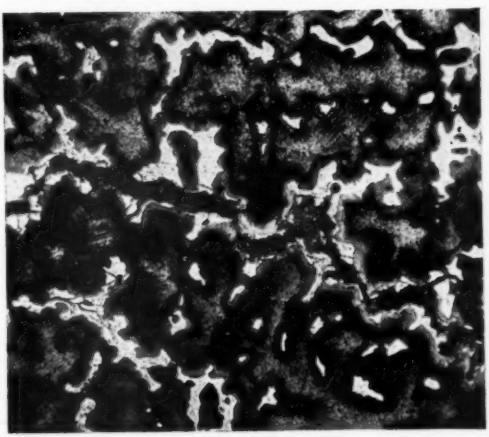
TABLE V.—*Ternary Bronzes (0.15 per cent. Phosphorus).*

Specimens.		Mechanical properties.			
Sn, per cent.	Designation.	Tensile Strength tons per sq. in.	Yield Point tons per sq. in.	Elongation, per cent. on 2$\frac{1}{2}$ in.	Reduction of area, per cent.
5	A	16.5	8.6	22.0	23.0
	B	17.3	8.8	25.7	24.0
	C	22.0	10.3	48.6	47.0
6	A	17.8	10.3	20.0	17.2
	B	18.6	9.8	28.3	29.0
	C	23.4	11.5	35.4	37.0
7	A	16.6	9.1	24.5	25.0
	B	18.2	10.2	28.3	29.0
	C	24.7	11.6	44.3	45.0
8	A	19.3	10.0	32.0	28.0
	B	20.4	10.0	32.8	28.0
	C	24.7	11.2	34.6	30.5
9	A	19.5	10.7	27.1	24.0
	B	21.0	10.5	33.5	26.5
	C	25.9	12.8	28.6	23.0
10	A	18.6	10.7	19.4	19.0
	B	19.0	10.9	19.7	17.0
	C	25.6	13.2	19.2	15.0
11	A	17.3	11.2	14.3	9.3
	B	18.5	11.9	14.9	12.0
	C	24.7	13.9	10.8	8.0
12	A	15.8	11.4	6.0	4.0
	B	17.6	20.3	8.6	8.0
	C	25.4	15.0	7.4	4.0

of the tensile stress until it fractures. The stress is then borne entirely by the α-matrix until the specimen itself fractures. Thus, it is reasonable to assume that when intercrystalline cracking does not occur (non-phosphorus bronzes), the tensile strength of the specimen decreases as the δ-content increases, since the stress is distributed over a decreasing area of usefulness.

On the other hand, when the alloy is prone to intercrystalline cracking (phosphor-bronzes), slipping is retarded by the inclusions. As these become more numerous, so the breaking load becomes higher. Micrographic examination confirms the

FIG. 8.—*Fracture in δ-phase.* × 250.



dilatometric analysis[2]. The distinction between the phosphor and non-phosphorus bronzes outlined earlier is, moreover, entirely relevant: with a very fine grain, *e.g.*, due to low temperature pouring in a sand mould, intercrystalline fracture occurs even with a phosphorus-free bronze. On the other hand, in the case of the metal mould, the fracture of phosphor-bronzes is usually transcrystalline, probably because the oxide films do not have time to

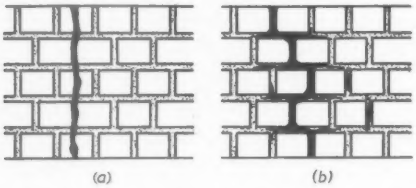


FIG. 9.—*The two modes of fracture (schematic): (a) transcrystalline and (b) intercrystalline.*

migrate to the grain boundaries during solidification. Some confirmation is afforded by the appearance of the fractures. These are often "granular"* or "oxidized" in the phosphor-bronzes, because despite care in melting, fracture occurs at the grain boundaries. Foundrymen who estimate the soundness of a casting from the appearance of a broken

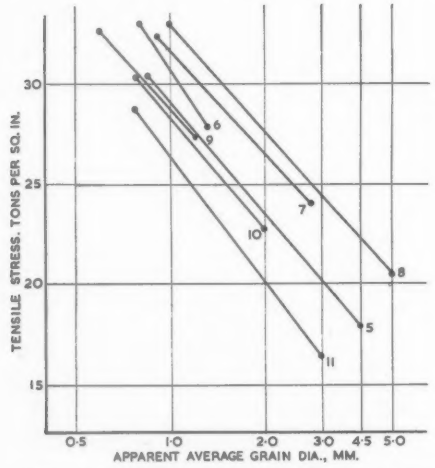


FIG. 10.—*Interpolated tensile stresses (2 per cent. zinc bronze).*

bar are determining, all things considered, whether the fracture is normal or premature.

The micrographic examination of fractured specimens thus enables the mechanical properties to be deduced, provided that one accepts the principle that intercrystalline fractures give lower values. For any comparison of mechanical properties, one

* "Terreuses," *i.e.*, "earthy" in the original.

TABLE VI.—*Ternary Bronzes (0.30 per cent. Phosphorus).*

Specimens.		Mechanical properties.			
Sn, per cent.	Designation.	Tensile Strength tons per sq. in.	Yield Point tons per sq. in.	Elongation, per cent. on 2$\frac{3}{4}$ in.	Reduction of area, per cent.
5	A	15.8	9.2	18.3	21.0
	B	16.7	9.7	20.6	24.0
	C	23.0	10.4	44.7	45.0
6	A	17.1	10.4	16.9	15.0
	B	17.1	10.3	16.6	19.0
	C	25.5	14.0	33.2	24.0
7	A	17.5	9.9	18.6	17.0
	B	18.7	10.6	25.1	19.0
	C	24.9	11.6	34.1	24.0
8	A	19.8	10.7	19.4	18.0
	B	18.9	10.4	18.9	16.0
	C	26.2	14.0	31.2	27.0
9	A	17.8	10.0	19.1	19.0
	B	17.1	9.7	14.3	17.0
	C	24.2	11.9	23.7	19.0
10	A	18.2	11.0	14.9	12.0
	B	18.7	11.4	13.7	10.0
	C	25.5	13.5	16.0	14.0
11	A	17.9	10.8	10.0	9.2
	B	18.1	10.8	10.2	10.0
	C	24.1	14.0	12.5	7.5
12	A	15.9	11.4	5.0	4.2
	B	16.6	11.7	6.0	5.0
	C	20.4	14.1	3.8	3.0

might prove the representative value of the results, but this would put the sand-cast phosphor-bronzes in an invidious position. Within the limits of the present investigation, the first objective of which was a comparative determination of the mechanical properties of the ternary bronzes, it will be seen that, on this basis, a large proportion of the results of the tests carried out

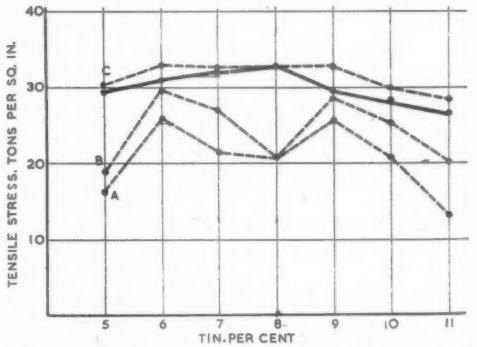


FIG. 11.—*True stress of 2 per cent. zinc bronzes for an apparent 1-mm. dia. grain size (solid line) compared with actual results for specimens A, B, and C (broken lines).*

must be rejected, even where the "rough" values appear to be correct.

Determination of Tensile Stress for 2 per cent. Zinc Bronzes

From the foregoing, it can be stated that comparative investigation of the tensile properties of

different α/δ bronzes (*e.g.*, according to tin content) must conform with the following conditions:—(1) The method of obtaining the specimens (depth from surface) must be uniform; (2) grain sizes must be equal; and (3) fractures must be transcrystalline. If the first two conditions are together complied with, it follows *ipso facto*, that the amount of δ-constituent will be definite. It is difficult to obtain completely uniform grain-sizes from one test-piece to another under experimental conditions. If, however, the stress, R′, is known for two different conditions of solidification of the same alloy, it may be accepted as a first approximation that the stress relative to a given grain-size can be estimated by interpolation. Thus, Fig. 10 shows in graph form the maximum stresses obtained for each of the 2 per cent. zinc bronzes studied in relation to the grain size of the specimens considered. Stresses were estimated for an average uniform grain-size of 1-mm. dia. The values obtained were transposed in Fig 11 to show the relationship with tin content. The resulting curve is regular, particularly if it be compared with the trend of those for the sand-cast specimens (A and B) where the grain size is not taken into account; the specimens with 8 per cent. tin would show an abnormal drop, but they are precisely those which showed the coarsest grain. Chill casting gives very much more significant results, and curves obtained under similar conditions will be found in the work of K. Winterton[3] or J. Krumpos[4]. The correction for grain size, however empirical it may be, is therefore of value.

The work reported in the present Paper was carried out in the Sèvres laboratories of the *Centre Technique des Industries de la Fonderie*. The Authors' thanks are expressed to Mr. A. E. Le Thomas for providing the facilities for conducting this investigation and for permission to publish the results.

REFERENCES.

[1] Mechanical Properties of Some Copper-base Alloy Castings. *Proc.* I.B.F., 1949, **42**, A134-A157.

[2] Le Thomas, P. J., Relationship between Structure and Tensile Properties of Sand-cast Tin-bronzes, *Fonderie*, 1955, No. 108 (January) pp. 4320-4329.

[3] Winterton, K., Mechanical Properties of Chill-cast Phosphor-bronzes, *J.* Inst. of Metals, 1945, **71**, 581-588.

[4] Krumpos, J., Influence of Melting, Melting Environment and Pouring Conditions on the Mechanical Properties of Tin Bronzes *Slevarenstvi*, 1955, No 12 (December), pp. 373-380.

Import Duty on Iron Castings

As a result of discussions held under the auspices of the General Agreement for Tariffs and Trade (GATT) at Geneva, a number of concessions in the rates of duty were made by the United Kingdom. Those affecting iron castings are as follow:—

(*a*) A reduction from 25 to 20 per cent. on castings, in the rough or machined weighing 7 lb. or over, other than gutters, domestic tanks and cisterns, where the value exceeds £40 per ton.

(*b*) A reduction from 20 to 17½ per cent. on cast tubes and pipes; and pipe and tube fittings of all kinds.

(*c*) A reduction from 33⅓ to 30 per cent. on motor-car parts.

(*d*) A reduction from 20 to 17½ per cent. on machinery and parts thereof.

International Foundry Congress

(*Continued from page* 46)

covering steel, malleable, cast iron, and non-ferrous metals. A further five lectures—in the afternoon—cover moulding and casting developments, shell moulding, use of small castings, shaping of castings to facilitate production and co-operation between designer and foundryman.

The following is a list of papers to be presented :—

Wednesday, September 5: "Semi-continuous Casting of Cast Iron," by Dr.-Ing. A. Wittmoser; "Italian Contribution to the Problem of the Basic Cupola," by Dr. D. Masperi, N. Noris and C. Ricci (Italian exchange paper); "Influence of Gas Scavenging on the Graphitization of Cast Iron," by G. Blanc and N. Volianik (French exchange paper); "Effect of Gas Scavenging on the Mg-consumption in the Production of Spheroidal-graphite Cast Iron," by Prof. Dr.-Ing. W. Patterson; "Study of the Oxide Patterns Appearing on the Surface of Molten Iron," by O. Madono (Japanese exchange paper); "Development of Internal Stresses Leading to the Cracking of Grey-iron Castings," by Dr. H. G. Angus and W. G. Tonks; "Elevated Temperature Testing of Sand and its Correlation with Casting Defects," by H. W. Dietert, V. Rowell and A. L. Graham (American exchange paper); "Studies on the Evaluation of Moulding Sands," by Prof. Dr.-Ing. H. Jungbluth; "Moisture-free Moulding Sand for Precision Castings," by K. A. Miericke; "Behaviour of Green-sand exposed to Sudden Heat in relation to the Formation of Scabs and Flow Marks," by H. G. Levelink (Netherlands exchange paper); "Some Aspects of Shell-moulding Theory," by Dr. B. H. C. Waters and A. Braybrook (British exchange paper); "Theoretical and Practical Problems of Bentonite Research," by Prof. Dr.-Ing. H. E. Schwiete.

Thursday, September 6: "Green-sand Moulding of Large Steel Castings," by C. W. Briggs; "Investigations on Sand Mixers and Sand Slingers," by Dip.-Ing. W. Gesell; "Investigation of the Isothermal Changes of Cu/Cr and Ni/Cr-Alloy Cast Iron," by Prof. A. De Sy and Ing. civ. mét. J. Van Eeghem (Belgian exchange paper); "Influence of Silicon and Phosphorus on the Annealing Brittleness of Malleable Cast Iron," by Prof. P. Bastien, P. Azou and Melle Winter; "Automatic 'Buhrer'-moulding and -casting plant at a Malleable Foundry," by W. Gotz (Swiss exchange paper); "Creep-resisting Steel Castings for Medium and High Temperatures," by Dip.-Ing. H. Zeuner; "Castability of some Nickel-base Alloys and other Nickel-containing Alloys," by D. R. Wood and J. F. Gregg; "Study of the Hydrodynamics of the Casting Process," by Prof. Dr. E. Scheil and Dr.-Ing. D. Pohl; "New Ways of Thermodynamics and Caliometry of Alloys, their Application on Iron and Steel," by Prof. Dr. phil.habil. W. Oelsen and Dr. E. Schürmann; "Measurement of the Surface Tension of Cast Iron," by Dr.-Ing. D. Pohl and Prof. Dr. E. Scheil; "Effects of the Treatment of Molten Casting Alloys," by Dr. phil. K. Löhberg; "Working-load of the Man in the Foundry," by Prof. Dr. med. G. Lehmann; "Application of the 'MTM' System in the Planning of Foundry-work," by Dip.-Ing. I. Edmann (Swedish exchange paper); "Future Foundry Research Problems," by Prof. Ove Hoff (Danish exchange paper).

During the Congress, there is offered a selection from 30 works visits, and from September 9 to 16, three post-Congress tours are planned, embracing a further 50 or more works visits. Throughout the whole period, full programmes for the ladies have been arranged complementary to those for the menfolk.

New Patents

(Copies of complete specifications are obtainable from the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s.)

749,464. Dr. C. Otto, and Company, G.m.b.H., Bochum, Germany, and Ko-We Niederschachtofen G.m.b.H., Bad Gotesberg, Germany.

A process for smelting ores in a shaft-furnace. The gas drawn from the furnace is heated to a temperature of at least 700 deg. C. at which condensable constituents of the gas are converted into permanent gases. The heated gas is then passed through a hot filter which has a solid filling including the raw material of the smelting operation. This is claimed to be a simple, safe process for the removal of harmful constituents of the gas such as bituminous coal.

749,529. C. J. Faulkner, Tin Research Institute, Fraser Road, Perivale, Greenford, Middlesex.

Composite bearings, comprising a sheet or strip of aluminium/tin alloy, having anti-friction properties backed by aluminium or tin-free aluminium alloy formed from a composite cast ingot forming one layer of aluminium or a tin-free aluminium alloy and a continuous layer of an aluminium/tin alloy. This is obtained by a combination of cold working and heat-treatment to globurize the tine, the sheet or strip being bonded by way of the tin-free layer to a steel backing shell.

749,544. Gebr. Bohler & Company A.G., Elisabethstrasse 12, Vienna, 1, Austria.

A method of cooling overhung, lowering, or withdrawal rolls in continuous-casting machines. A cooling agent flows through a bore in the roll shaft, and from there into a cavity in the roll, and issues from the latter through a spraying or atomizing nozzle at the free end of the roll.

749,546. Universal Castings Corporation, 5821 W. 66th Street, Chicago, Illinois, USA.

A method of casting which comprises forming a mould of upper and lower sections of porous ceramic material. Registering recesses are provided in each of the sections to define a cavity. A supporting plate is placed under both sections. A clamping plate, with one or more channel-like passages, is adapted for connection with excavating means. These plates and sections are clamped together adjacent to the contiguous exterior surface of the mould sections. A vacuum is applied by way of the passages, and the material to be cast, in a fluid state, is introduced into the cavity and allowed to solidify. It is claimed that castings made by this method have improved physical properties, and precision castings have been made under production conditions and speeds with thin-walled sections to a specification accuracy of .005 in.

749,586. Magnesium Elektron, Limited, Lumm's Lane, Clifton Junction, nr. Manchester, Lancs.

A method of reducing the content of rare earth-metals in magnesium-base alloys containing thorium and rare earth-metals. Intimate contact between magnesium chloride and the alloys throughout the body of the alloy is effected at a temperature of 650 to 750 deg. C. Maintained over the alloy is a substance capable of minimizing the tendency to oxidation.

749,759. Cop-Sil-Loy Inc., 1595-97 Cross Roads of the World, Hollywood, California, USA.

A process of making a completely homogeneous alloy of lead and copper and/or silver. Lead is introduced into a molten mass of copper and/or silver which is covered with a protective flux, consisting essentially of hematite ore. The mixture is vigorously stirred while applying heat until the temperature of the mixture is brought back to approximately the temperature of the molten copper and/or silver before the lead was introduced. The invention also relates to frictional compositions adapted to be used as a coating for friction members such as the brake and clutch elements of cars.

749,761. George Blair & Company, Limited, Armond Carr Works, Tow Law, Co. Durham.

A metal mould for the production of hollow, iron and steel castings. A pouring gate is provided in a sand core with a moulding space between the core and the internal surface of the metal box. The mould has an insert of refractory material, disposed so that its exposed face is a portion of the internal surface and receives the impact of the molten metal flowing into the moulding space through the gate. This method is stated to reduce the rapid erosion normal in moulds for the production of hollow castings.

Notes from the Branches

South Africa

Mr. J. A. de Kiewet presided at the May meeting of the South African branch of the Institute of British Foundrymen. The lecture, entitled "Aluminium Die-casting," had been prepared in German by Mr. J. Dohmen and translated by Mr. A. F. Kukla, who also presented the Paper, and with the assistance of Mr. Dohmen replied to the discussion. The Author dealt with the types of aluminium alloys suitable for die-casting and strongly recommended the purchase of first-grade ingots in preference to having the diecaster preparing his own alloy from scrap. Die material, die design and running methods were dealt with in a further section. Several photographs of die-cast components were shown and in some of these the use of shell cores for intricate cavities was illustrated. One photograph showed eight die-castings which were required for a fuel pump—comparison between sand and die-castings showed a saving by the latter method of 33.5 per cent. of the cast weight and a reduction in the number of machining operations from 21 to 5.

Discussion

The discussion was opened by Mr. J. A. de Kiewet, who congratulated Mr. Dohmen on his Paper and Mr. Kukla on his translation and presentation. He endorsed the Author's remarks concerning the use of high-quality ingot metal. Replying to a question, Mr. Dohmen stated that he checked his die temperatures by means of a "temperature stick" and never commenced to use a die till it reached 350 deg. C. For best results, he preferred a very hot die and metal of the lowest possible pouring temperature. Other points in the discussion dealt with "breaking-in" of new dies, ceramic dies, and die wall-thickness in relation to the weight of metal to be poured. A vote of thanks, proposed by Mr. K. H. Coombs, was carried with acclamation.

Australian (Victoria)

The May meeting of the Australian (Victoria) branch took the form of a round-table discussion on foundry fuels. Mr. W. S. Nichols spoke upon oil; Mr. L. H. Bismire on gas and Mr. H. A. Stephens, B.Sc., on foundry coke.

Equipment and Supplies

Kolene Process*

The Kolene Process is quite well known in the United States, and was originally brought to this country by Mr. G. Hyslop, when managing director of the Phosphor Bronze Company, Limited. Since that time, a subsidiary of the Birfield organization (which incorporates the Phosphor Bronze Company) called Castingite, Limited, at Stone Yard, Deritend, Birmingham, 12, has been formed to operate the Process in all its aspects. Basically, the system consists of treating components—especially castings with intricate cored holes from which sand is difficult, if not impossible, to remove by conventional methods—in a bath of molten salts, mainly caustic soda. The solvent properties of the salts are controlled and probably enhanced by the introduction of electrical energy supplied at 6 to 8 v., d.c., and at an amperage suited to the size and volume of the work to be processed.

At the time of the writer's visit to Castingite, Limited, iron castings weighing about 30 to 35 lb. were being treated. They were for a hydraulic-engineering purpose and contained deepseated cored holes. The castings were loaded into the type of basket shown in Fig. 1, hoisted on to a monorail spanning a series of enclosed baths. The monorail took them to the far end of the plant and lowered them into the bath of hot alkali, where the lips of the basket made the necessary electrical contact. After about 10 to 15 min., the castings were transferred to a cold-water bath and a few minutes later to a hot-water tank. On removal from this tank there is sufficient residual heat to dry the castings and prevent rusting.

The application of the Process is particularly wide, one interesting case being where iron castings have to be tinned for use in connection with food preparation. Another important potential application is for water-jacket castings or castings with cored oil-ways, where residual sand which became dislodged in service could be disastrous to the life of an engine. By varying the Process, the graphite contained in the skin of an iron casting can be removed, so leaving a ferritic surface, much better suited to the tinning process. The plant inspected is centrally situated in the Birmingham area and well placed for servicing local works. Where large quantities of components have to be processed, then complete plant can be supplied. Another activity of this modest but interesting firm is the exploitation of the impregnation of castings to seal blowholes and make components pressure-tight. The tank is about 5-ft. 6-in. dia. and so can cope with quite large castings.

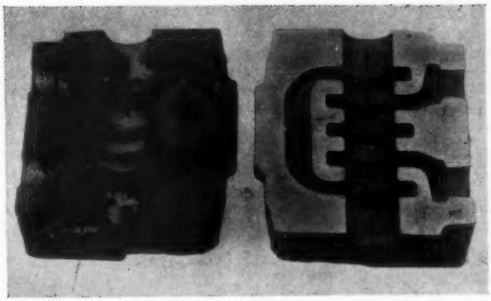


FIG. 2.—*Sectioned iron casting—containing intricate cored holes—before and after treatment by the Process.*

* A description of the Process as practised in America was printed in the JOURNAL, May 17, 1951, page 529 *et seq.*

Wire-belt Slings

British Wedge Wire Company, Limited, Academy Street, Warrington, Lancs, have recently released to the general market, "Wedco" wire-belt slings, the standard range of which uses heavy-duty 10-gauge steel-wire fabric suitable for the majority of applications. For special applications slings of different fabric meshes can be supplied in a variety of materials. The widths available range from 3 to 18 in., giving safe working loads from 1 to 7½ tons when using a choke hitch, and double these figures for a basket hitch. For each sling, the safe-working load is stamped on a metal nameplate attached to the female handle. The transverse looped wire construction of the belt eliminates kinking or tangling and permits the sling to bend easily around articles of small diameter.

FIG. 1.—*View of the plant at Castingite, Limited, for carrying out the Kolene Process.*

Company News

COWANS, SHELDON & COMPANY, LIMITED, engineers, cranebuilders, etc., of Carlisle—For the period from July 1, 1955, to April 6, 1956, the dividend is 11¼ per cent., which compares with 15 per cent. paid in the preceding 12 months.

B. O. MORRIS, LIMITED, makers of flexible shaft and grinding machines, of Coventry—For the year ended January 31 the ordinary dividend is maintained at 15 per cent., but a bonus of 5 per cent. is being paid, compared with 2 per cent. in the previous year.

JAMES SCOTT & COMPANY (ELECTRICAL ENGINEERS), LIMITED—A final dividend of 13 per cent., making 18 per cent. for the year to January 31, 1956, against a forecast of 17½ per cent., is recommended on the ordinary capital of the company which was made public in July last year.

BRITISH GLUES & CHEMICALS, LIMITED—The ordinary dividend for the year ended March 31 is effectively raised to 15¼ per cent. from 13¼ per cent. for 1954-55, allowing for the one-for-two capitalization issue last February. The final payment is 12 per cent., against the equivalent of 10 per cent. for 1954-55.

LAKE & ELLIOTT, LIMITED, steelfounders, of Braintree (Essex)—The directors state that the new shares resulting from the two-for-three scrip issue to holders on July 19 will rank for any further dividend in respect of the year to July 31, 1956. They expect to maintain the final dividend rate at 7½ per cent. on the increased capital.

ALUMINIUM CASTINGS COMPANY, LIMITED—Before proceeding with the scheme to reorganize and increase the present £448,309 capital, the directors are seeking confirmation and court sanction for a scheme of arrangement, approved by shareholders in 1945, whereby 5,000 preference £1 shares were converted into ordinary shares.

JOHN HARPER (MEEHANITE), LIMITED—The directors propose capitalizing £10,000 of general reserve to make a scrip issue of 200,000 1s. shares to holders registered on July 16, in the proportion of one for every four. Application will be made to the Birmingham Stock Exchange for a quotation for the new shares, which do not rank for the 1955-56 final dividend.

BIRFIELD, LIMITED—After conversion of part of the ordinary capital into non-voting preference shares for retention by the Ford family, the company has acquired all the ordinary share capital of T. B. Ford Limited, now outstanding. Mr. H. E. Hill and Mr. W. R. Sharland are joining the board of T. B. Ford but no other changes in the board, the management, or the business of that company are envisaged.

EDGAR ALLEN & COMPANY, LIMITED—Advances in costs, not possible to recoup in selling prices, resulted in substantially lower group trading profits in the year to March 31 last. The ordinary dividend proposed is 12½ per cent., as for the previous year. Group turnover was slightly increased, although that of the parent was down by some 4 per cent. due to temporary slackening in engineering department activity, partially offset in other directions.

BILSTON FOUNDRIES, LIMITED—Although the company's plant is at present fully occupied, it is difficult to forecast the immediate future, says Mr. H. C. Sargent, chairman, as finance for new house building has become more difficult to obtain. However, he has "no fear" but that the company will get a substantial share of the available trade during the year to March 31, 1957. New lines have recently been introduced and others are being developed.

OCEAN WILSONS (HOLDINGS), LIMITED—The special resolution approving repayment in cash of the whole of the preference capital and 3s. on each ordinary share was passed at the recent meeting. Mr. F. A. Stacpole, chairman, said that although the board might, in future, make other repayments, it had nothing of this kind in mind at the moment. Transfer of the Brazilian undertaking to a new company is hoped to be completed in a few months. The transfer will involve a number of adjustments, and shareholders may anticipate sizeable debits to Wilsons' profit and loss for 1956, while it may be technically difficult to bring earnings into the parent's accounts from the new Brazilian subsidiary until 1957.

Cutting Industry's Fuel Bill

To those industrialists engaged in the all important task of seeking ways to reduce production costs, fuel efficiency has long been preached as a sound method. Just how much can be achieved in this field will be demonstrated at the Fuel Efficiency Exhibition at Olympia, in London, from October 2 to 10. It will be opened by the Minister of Fuel and Power and about 150 firms will be showing special equipment designed to produce fuel economy in all branches of industry.

The exhibition, which is claimed to be the largest of its kind in the world, is under the auspices of the National Industrial Fuel Efficiency Service and the Combustion Engineering Association. It is being organized by Provincial Exhibitions, Limited, and is coming to London for the first time as such great interest was shown in it in previous years when it was staged in Manchester. It is intended to show ways in which industry can save up to one fifth—and often more—of its fuel costs; to show how nuclear energy can save our fuel there will be exhibits outlining the development of nuclear power stations by the Central Electricity Authority and the use of nuclear power for peaceful purposes by the United Kingdom Atomic Energy Authority.

During the course of the exhibition the Institute of Fuel is organizing a series of talks and discussions under the title of the "Efficient Use of Fuel in Industry." The subjects cover the efficient use of coal, efficient use of oil and gas, heat and power surveys and waste heat, and clean air and industry. These will be followed by a free discussion and a summing up of the four sessions to be held.

New Furnace for Amcor

African Metals Corporation (AMCOR), an associate company of ISCOR, is to build an additional blast-furnace which will more than double the output of its Newcastle works. The new furnace will have an annual capacity of 180,000 tons of all grades of pig-iron, and when it is in production—expected towards the end of 1958—it is estimated that sufficient pig-iron will be available to meet requirements for some time in the future. It is stated by the company that as much as possible of the necessary materials and equipment will be obtained locally. The two existing blast-furnaces at Newcastle are producing various grades of foundry pig-iron amounting to 150,000 tons annually. Until the full pig-iron production is taken up by the local market, AMCOR will be able to use some of the blast-furnace capacity to increase its exports of ferro-manganese.

News in Brief

A KEIGHLEY BRASSFOUNDER, Mr. J. P. Finan, who had a deficiency of £1,361, appeared for his public examination at Bradford Bankruptcy Court on July 5.

A NEW FACTORY is being built at North Cardonald, near Hillington, for Wickman, Limited, machine tool manufacturers, who have been at Hillington since 1939.

AERO RESEARCH, LIMITED, Duxford, Cambridge, announce that, with effect from July 7, their telephone number has been changed to Sawston 2121; the Telex number is 10-101.

PREMIER ALUMINIUM CASTING COMPANY, LIMITED, announce that their new address is Beehive Works, Old Birchills, off Green Lane, Walsall, Staffs; (telephone No.: Walsall 6581/8).

POLYGRAM CASTING COMPANY, LIMITED, of Power Road, Gunnersbury, London, W.4., announce that Mr. E. S. Haynes has been appointed their representative for the Midland Counties area.

NEW SHOWERBATHS with heated lockers have been installed at a cost of £18,000, for the 160 moulders and labourers at the North-Eastern Foundry, South Shields, owned by Charles W. Taylor & Son, Limited.

A FORMAL DECISION has been made by the Ministry of Pensions and National Insurance that a research student should be treated as being in full-time education and so excused from paying national insurance contributions.

BRITISH TRANSPORT COMMISSION announce that they have placed a contract with G. R. Turner, Limited, Langley Mill, Nottinghamshire, for eighty 50-ton bogie rail wagons in connection with the railway modernization plan.

IT IS ANNOUNCED that developments costing £1,500,000 at Loughborough College of Technology will give it the status of "College of Advanced Technology." It is expected that the college would be expanded to take 1,200 full-time students.

THE COUNCIL OF IRONFOUNDRY ASSOCIATIONS, 14, Pall Mall, London, S.W.1, has just issued a list in pamphlet form of the visual aids they handle. These include 16 mm. films; film strips and wall charts. The list is now quite impressive.

THE 29th International Congress of Industrial Chemistry is to be held in the *Salons de la Chemie*, Paris, from November 18 to 24. The 4th Chemical, Rubber and Plastics Exhibition will open on November 22 and will continue to December 3.

IN THE FIRST SIX MONTHS of this year, the tide of production which last year reached a "highest ever" peak at Leyland Motors, Limited, has already exceeded by more than 13 per cent. the high level reached in the first six months of 1955.

UNDER a licence agreement with Werkspoor N.V., Amsterdam, Armstrong Siddeley Motors, Limited, will make and sell the Dutch company's high-speed diesel engines for rail traction and shipping in Great Britain and throughout the British Commonwealth.

THE BRITISH CAST IRON RESEARCH ASSOCIATION is organizing a conference to be held at the Connaught Rooms, Great Queen Street, London, W.C.2, from November 28 to 30 inclusive, to deal with the engineering properties and uses of grey-iron castings.

W. CANNING & COMPANY, LIMITED, Birmingham, have established a research scholarship, of the value of £600 a year, to be held in the Department of Metallurgy at the University of Nottingham. The scholarship will be awarded for research in the field of metal finishing.

BECAUSE of a reduction in orders from the motor trade, 350 workers employed at two of the four foundries in Derby of Qualcast, Limited, have started a four-day working week. An official of the company said that the step had been taken in consultation and agreement with the representatives of the employees.

DESPITE KEEN COMPETITION from both European and American firms, Spooner Food Machinery Engineering Company, Limited, Ilkley Hall, Ilkley, have secured an order worth half a million dollars (about £180,000) from Oakland and Buffalo bakeries of the National Biscuit Company, for the supply of ovens.

SCROLLS containing congratulatory addresses to the Society of Chemical Industry on its seventy-fifth anniversary were presented at a ceremony in London on Tuesday. Delegates from learned societies in Britain and abroad presented the scrolls to the president of the society, Mr. Julian M. Leonard, at the Royal Institution.

ELEVEN APPRENTICES of Samuel Osborn & Company, Limited, steelmakers, Sheffield, went at the firm's expense to London, on June 29, to visit the Machine Tools Exhibition at Olympia, and afterwards made a sight-seeing tour of the capital. They had been chosen out of the 200 apprentices of the firm for their special merit at work.

A SPECIAL ALLOCATION of £120,000 will be provided in 1957 by the University Grants Committee for the building of the first part of a new engineering block for University College, London, it has been announced by Sir Ifor Evans, Provost of the college. The appeal to industry for an initial fund of £300,000 to begin the building has brought in £306,000.

E. P. BARRUS (Concessionaires) Limited, 12 to 16 Brunel Road, Acton, London, W.3, have been appointed sole agents for the sale of Devcon, manufactured by the Devcon Corporation, Danvers, Mass., USA. The material is a combination of 80 per cent. steel and 20 per cent. plastics and as it adheres to all sorts of metals is used for repair jobs.

Mr. B. A. KOSTOUSOV, Minister of Machine Tools and Small Tools of the Soviet Government, with Mr. Greihukhain, a fellow delegate, arrived by air at Yeadon, near Leeds, last Thursday, on a lightning visit to the machine tool firm of William Asquith, Limited, Highroad Well Works, Halifax. They were accompanied by the company chairman, Mr. Robert Asquith.

A STAND illustrating right and wrong methods of using wire ropes and slings has been prepared by Martin, Black & Company (Wire Ropes), Limited, Coatbridge, Glasgow, at the request of a nationalized industry as part of its campaign to reduce the number of industrial accidents. The stand will be part of a travelling exhibition which will tour the London area before visiting the provinces.

A FURTHER £16,000,000 is to be spent by Imperial Chemical Industries, Limited, on major extensions at Wilton-on-Tees. These include a third oil-cracking plant scheduled for completion in 1959. ICI's total investment at Wilton already exceeds £50,000,000, and it is estimated that by 1959 the company's aggregate polythene capacity will exceed 90,000 tons a year—more than three times the present level.

A SOLID SILVER SALVER, bearing the "Dragon" emblem of the Steel Company of Wales, Limited, has been presented to Mr. Damien, of the USINOR Works, Denain, France. Earlier this year the fracture of the shears spindle in the Abbey Works slabbing mill

News in Brief

threatened a serious loss in production. This was averted when a spare spindle, loaned by USINOR, was brought to Margam after a hectic rail and sea dash.

F. BURNERD & COMPANY, LIMITED, whose new address is 5, Balfour Place, Park Lane, London, W.1, exhibited their Griptru lathe chucks at the recent International Machine Tool Exhibition at Olympia. One exhibit was a 6-jaw chuck holding an ordinary glass tube without damage—at the maximum possible pressure, and another model showed a 15-in. disc being held within 0.00005 concentricity.

GILBERT GILKES & GORDON, LIMITED, Canal Iron Works, Kendal, Westmorland, who since 1856 have exported turbines and pumps to many countries, are celebrating their centenary this year. The firm was started by two Kendal businessmen, the Williamson brothers, and in 1881 it was sold to Gilbert Gilkes. In 1928, the water power business of James Gordon & Company, Limited, was acquired.

Mr. J. C. M. MACLAGAN, managing director of Greenwood & Batley, Limited, engineers, Albion Works, Armley Road, Leeds, welcomed the Lord Mayor of Leeds, Alderman T. A. Jessop, and the Lady Mayoress, when they visited the firm's heavy-tool department recently. The Lord Mayor worked in the department in his youth and he met three men who were still there from those days. The firm celebrates its centenary this year.

AT THE JULY LUNCHEON of the Non-Ferrous Club the guest speaker was Mr. T. C. James, chairman of the Wolverhampton Metal Company, Limited. Mr. James spoke about his experiences in the trade over the past 50 years, and described the growth of the company during that period. At this luncheon a collection was taken on behalf of the National Society for the Prevention of Cruelty to Children, the sum realized being £26. No luncheon will be held during August.

NEW IMPORT RESTRICTIONS imposed by the Australian Government mainly affect Category "B" unessential goods. Imports of goods in each of the seven sub-categories in this section, which includes metal manufactures, appliances, and equipment, will be reduced from 25 per cent. to 33⅓ per cent. Imports of fully assembled motor vehicles will be cut by 50 per cent. and those in a completely knocked-down condition by 30 per cent. in the third quarter of the year.

SAFETY PRODUCTS, LIMITED, announce that in consequence of increasing demand for the "Pulsafe" industrial safety equipment, they have recently acquired larger and more modern factory premises at Holmethorpe Avenue, Redhill, Surrey. Here will be the main offices and warehouse, but a small office is being retained at St. George's House, 44, Hatton Garden, London E.C.1. All communications should henceforth be addressed to Redhill, where the tele phone number is Redhill 4304 and 4305.

THE RECORD figures of trade and profit realized by the Morgan Crucible Company, Limited, in 1954-55 were exceeded in the year to March 31, 1956, but profits have not risen in proportion to the sales volume increase, due to competition abroad and strains on the home industrial economy. Mr. P. Lindsay, chairman, says the consequent shrinkage of margins has only been partially offset by a modest improvement in productivity. Sales income was 15 per cent. higher and oversea sales still constitute 42 per cent. of total turnover.

FAST FACTORY-TO-SHIP TRANSITS for small freight consignments for export will be given by new facilities introduced by British Railways on July 2 at their Birmingnam, Curzon Street, depot. This depot is to serve as a concentration point, where goods for export from the Birmingham and South Staffordshire industrial areas will be assembled into through wagon loads for individual ships at the main ports. The service will not only speed up urgent export traffic but should materially help to relieve road congestion at the docks. Similar depots in other large manufacturing areas are being considered.

A SCOTTISH FIRM is to share in a contract worth several million pounds to harness the hot springs of New Zealand for electrical power. The firm, Munro & Miller, Limited, Glasgow, are to supply pipes for the undertaking—New Zealand's first geothermal power station. This share of the contract runs into several hundreds of thousands of pounds, and the firm will be sending out a large number of skilled men, the first party leaving for New Zealand within the next few months. The station is to be built at Wairakei. The London firm of Holland, Hannen & Cubitts is also to share in the contract for the construction of the power station.

"THE STEEL ROAD," a documentary film made for the Workington Iron and Steel Company, Limited, to celebrate this year's centenary of Sir Henry Bessemer, has been chosen for presentation at the Venice and Edinburgh Film Festivals. It will be shown at Workington when the Queen visits the steel works in October. The film was commissioned by the United Steel Companies, Limited, and is in colour. It lasts for 23¼ minutes and shows the application of the Bessemer process at Workington Iron and Steel Company. The film will also be shown at the British Association meeting in Sheffield in August, and the B.B.C. are televising it on August 14, when Robert Reid, of "Special Inquiry," and Langton Highton, managing director at Workington, will introduce it.

Mr. F. N. Goss, works manager of the British Aluminium Company's Lochaber factory, in a recent statement, said the firm's decision to set up an aluminium smelter plant in the Province of Quebec did not mean that the company intended to transfer all their operations to Canada. The reason for starting a smelter in Quebec, he said, was because the company wished to expand ingot production and to make themselves independent of other producers: the aluminium producing industry in this country was incapable of expansion through lack of power at an economic price. The ingot tonnage produced at Kinlochleven and Lochaber works provided less than half the intake required for the company's fabricating plants, whose needs continued to grow. Mr. Goss said that about £250,000 was being spent on modernizing and reconstruction of the Lochaber factory.

"Production Moulding of Components for Cast-steel Bogie Trucks." Mr. J. G. H. Loubser, the Author of the Paper appearing under this title in the May 3 issue of the Journal, has pointed out two errors: (1) his own position should have been described as engineer-in-charge of the production planning office of the South African Railways and (2) the caption to Fig. 2 should read "Moulding machines manufactured in the railway workshop in Pietermaritzburg of the South African Railways Administration."

On his retirement after 49 years' service with Ashmore, Benson, Pease & Company, gas-plant manufacturers, etc., of Stockton-on-Tees, MR. J. B. ARCHER, production manager, has received a presentation.

Personal

Mr. R. ASKIN has been appointed a director of J. Brockhouse & Company, Limited. Previously he acted as an executive director.

Mrs. W. H. HIGGINBOTHAM, wife of the chairman of Edgar Allen & Company, Limited, Sheffield, performed the opening ceremony at the first children's gala on June 30, at Bawtry Road, arranged by the sports club.

Mr. S. S. GOSLING, chief buyer at Belliss & Morcom, Limited, Birmingham, was presented with a cocktail cabinet and an autograph book signed by fellow workers, on his retirement on June 29, after 61 years with the firm.

Mr. GEORGE MIDDLETON, aged 77, the longest serving employee at William Jessop & Sons, Limited, steelmakers, Sheffield, retired on June 30 after 64 years with the firm. He started work as a cellar lad at 9s. a week, and was later in the crucible-steel department as a teemer.

The Institution of Production Engineers announce that Mr. E. W. HANCOCK, M.B.E., has been elected president. The new chairman of the Council is to be Mr. H. G. GREGORY, who is manager of the northern factories of the Fairey Aviation Company, Limited.

Fordath Engineering Company, Limited, West Bromwich, announce the retirement after 23 years of service of Mr. CHARLES ROBERTS, who was Scottish area technical and sales representative. He is succeeded by Mr. JOHN FINLAY, who is well known in Scottish foundry circles and was formerly with Cruickshanks, Limited, of Denny.

MR. CHARLES ORD, head of the wages department at the steel foundry of W. Shaw & Company, Limited, Middlesbrough, for the past 28 years, and an employee of the firm for 50 years, has been presented with a wallet of notes on his retirement. The presentation was made on behalf of staff and workmen by Mr. G. Shaw, chairman of directors.

Mr. GEORGE MACKENZIE, who has been working on an assignment at the British Divisions of the Yale & Towne Manufacturing Company for the past two-and-a-half years, has now finished his work there and on July 1, he left for the German Division of the company where he is to spend some time before returning to the New York headquarters of the parent body of Yale & Towne.

Mr. H. MORROGH, research manager, British Cast Iron Research Association, has been awarded the Sir Robert Hadfield Medal of the Iron and Steel Institute for 1956. This well-merited award is the fourth Mr. Morrogh has received, the others being the Andrew Carnegie gold medal, the E. J. Fox gold medal and W. H. McFadden medal of the American Foundrymen's Society.

A presentation was made to Mr. H. W. H. ICOUGH on the occasion of his retirment after 50 years in the service of G. A. Harvey & Company, (London) Limited. His special interests were wire weaving and municipal activities. In the former activity he became chairman of the executive committee of the Woven Wire Manufacturers' Association in 1942. He was Mayor of Greenwich in 1938/39.

The board of the new subsidiary company of Brightside Engineering Holdings, Limited—Brightside Foundry & Engineering Company, Limited, consists as follow: Mr. T. C. FIRTH (chairman), Mr. AMBROSE FIRTH, Mr. E. HALLAS, Mr. W. UDALL and Mr. P. WRIGHT. Mr. R. I. SLATER has been appointed a director of Brightside Heating & Engineering Company, Limited, another subsidiary.

Mr. G. H. GREENHALGH joins the Department of Scientific and Industrial Research this month as scientific attaché in Scandinavia. He is being loaned to DSIR by the Atomic Energy Authority's Research Establishment at Harwell and he will take up his duties in Stockholm in August after briefing in this country. Mr. Greenhalgh succeeds Mr. R. G. SILVERSIDES, who has returned to DSIR headquarters.

Eighty-four-year-old Mr. A. F. SHIRT retired on June 30 after 65 years' service with the firm of Thos. W. Ward, Limited, Albion Works, Sheffield. He had been associated with the foundries supply section for most of the time, but latterly had been manager of the company's sand quarry at Mansfield. Mr. Ashley S. Ward, president of the company, presented him with a cheque on behalf of the directors, and from his colleagues he received a case of pipes and tobacco.

Mr. A. K. JORDAN, assistant general sales manager, Northern Aluminium Company, Limited, has left the company to take up the post of general sales manager with Aluminum Company of Canada, Limited (Alcan). Mr. Jordan was Alcan's export sales manager before joining Northern Aluminium in 1951. Apart from wartime service with the Canadian Army, which he left with the rank of lieutenant-colonel, he has been with the Aluminium Limited group for 26 years. He is succeeded by Mr. J. H. MAYES, who joined the technical department of the company in 1934, and latterly has been responsible for the export sales departments.

Last month, a ceremony was held at the Manchester works of Mather & Platt, Limited, to mark the fortieth anniversary of the accession of Mr. LORIS E. MATHER to the chairmanship of the company. Past and present employees of the firm had subscribed for the painting of a portrait of the chairman and this work, by Edward Halliday, was presented to him by Mr. T. Y. Sherwell, the senior director. Mr. Mather, who is also a director of the Lancashire Steel Corporation, Limited, has in his long association with engineering held many appointments of significance. He served as Regional Controller, Ministry of Production, from 1942 until 1945, and he is vice-chairman of the North-Western Regional Board for Industry.

Obituary

Mr. WALTER GEORGE TUBMAN, who died on June 30 at the age of 65, had been secretary of the British Steel Producers' Conference of the British Iron and Steel Federation since 1946. He joined the forerunner of the BISF, the National Federation of Iron and Steel Manufacturers, in 1920.

Mr. H. E. MIDGELEY, a director and vice-chairman of Newton Brothers (Derby) Limited, electrical engineers, died on July 1 at the age of 76. He had been associated with the company for more than 20 years. He was also a director of the Brush Electrical Engineering Company, Limited, Loughborough.

The death of Mr. GEORGE MARLOW GRAHAM is reported from Jerpeland, Norway. Mr. Graham was trained in the metallurgical department of Sheffield University. After some experience in the local steelworks, where he specialized in the electric melting of steel, he was appointed metallurgist to the Stavanger Electro-Staalverk A/S. He remained with this company for over 30 years, and for many years had been a director. During the war he was interned both in Germany and Norway.

Imports and Exports of Iron and Steel in May

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in May. Totals for the first five months of this year and last are also included.

Total Exports of Iron and Steel

Destination.	Month ended May 31.	Five months ended May 31.	
	1956.	1955.	1956.
	Tons.	Tons.	Tons.
Channel Islands	331	2,841	2,291
Cyprus	1,105	2,242	3,019
Sierra Leone	332	4,352	2,407
Gold Coast	2,137	11,671	11,247
Nigeria	2,522	19,831	24,302
Union of South Africa	5,133	35,324	33,365
Rhodesia and Nyasaland	10,078	31,205	34,960
Tanganyika	2,546	6,892	8,114
Kenya	5,049	25,239	22,412
Uganda	647	1,943	2,585
Anglo-Egyptian Sudan	402	9,138	7,226
Mauritius	360	1,127	1,094
Aden	814	4,493	2,821
Bahrain, Qatar, and Trucial States	417	5,984	4,375
Kuwait	184	1,702	1,628
India	26,524	57,892	132,451
Pakistan	2,988	21,648	18,708
Singapore	2,252	16,896	13,455
Malaya	3,387	8,603	15,738
Ceylon	3,278	8,226	15,832
British North Borneo	936	1,902	3,013
Hongkong	5,141	21,131	25,987
Australia	21,289	192,688	99,160
New Zealand	14,845	121,711	86,185
Canada	30,096	43,316	115,770
Jamaica	1,517	5,429	10,637
Trinidad	2,737	23,369	15,676
British Guiana	390	2,943	2,176
Other Commonwealth countries	1,948	10,645	10,739
Eire	5,979	23,828	30,570
Finland	7,145	32,488	23,103
Sweden	9,833	59,416	53,704
Norway	7,724	57,868	35,913
Denmark	8,271	37,179	28,772
Western Germany	1,717	2,745	4,994
Netherlands	8,026	44,292	36,791
Belgium	4,900	9,727	18,223
France	1,059	2,557	3,648
Switzerland	1,328	6,711	6,165
Portugal	838	5,889	3,883
Spain	3,285	32,017	14,767
Italy	2,140	12,826	8,738
Austria	420	1,298	2,139
Yugoslavia	3,330	9,229	4,532
Greece	648	4,905	2,572
Turkey	775	4,413	1,930
Netherlands Antilles	456	5,861	4,632
Portuguese E. Africa	193	711	1,178
Lebanon	589	2,801	3,962
Egypt	4,302	13,514	21,741
Israel	848	4,607	4,679
Saudi Arabia	3,512	4,190	6,546
Iraq	2,004	22,793	15,710
Iran	3,030	25,445	34,227
Burma	184	6,585	2,766
Thailand	289	2,378	3,494
Indonesia	306	1,573	4,726
Philippine Republic	995	2,689	2,864
USA	4,625	19,080	20,252
Cuba	677	1,768	4,604
Colombia	411	3,355	1,320
Venezuela	5,022	26,223	29,698
Ecuador	579	1,256	1,464
Peru	1,822	4,702	7,535
Chile	109	571	367
Uruguay	263	3,418	2,050
Argentina	5,816	28,301	22,755
Other foreign countries	3,212	16,330	12,861
TOTAL	256,047	1,245,922	1,217,248

Total Imports of Iron and Steel

From	Month ended May 31.	Five months ended May 31.	
	1956.	1955.	1956.
	Tons.	Tons.	Tons.
Rhodesia and Nyasaland	218	1,574	1,064
Australia	42	43	56
Canada	5,282	44,897	23,879
Other Commonwealth countries and Eire	356	4,653	2,552
Soviet Union	26,901	88,877	131,351
Sweden	6,277	12,508	20,151
Norway	7,214	30,810	43,510
Western Germany	15,564	10,800	105,038
Netherlands	4,210	53,279	49,827
Belgium	31,093	43,718	180,941
Luxembourg	4,081	12,934	30,659
France	20,494	72,328	132,844
Italy	1,113	174	5,488
Austria	9,555	60,487	78,215
Japan	718	3,276	7,592
USA	41,353	283,836	283,446
Other foreign countries	19,076	5,165	37,698
TOTAL	193,547	729,359	1,134,311
Iron and steel scrap and waste, fit only for the recovery of metal.	86,622	485,620	410,335

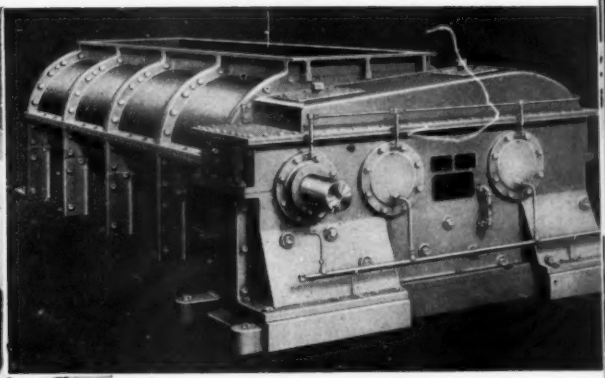
Exports of Iron and Steel, by Product

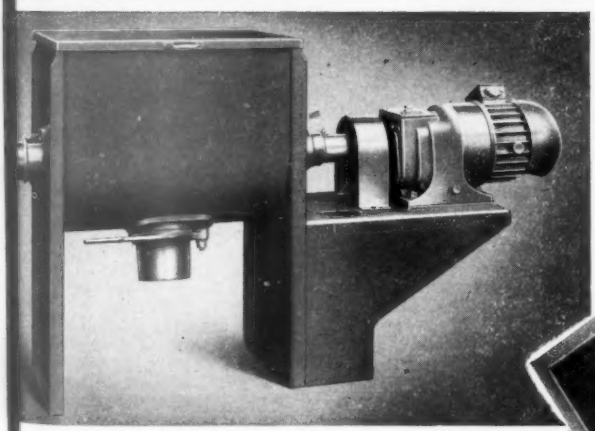
Product.	Month ended May 31.	Five months ended May 31.	
	1956.	1955.	1956.
	Tons.	Tons.	Tons.
Pig-iron	12,378	24,742	50,090
Ferro-colombium (niobium)	16	44	82
Ferro-tungsten	118	213	471
Other ferro-alloys	323	1,177	1,647
Ingots, blooms, billets, slabs, sheet, and tinplate bars	174	2,972	1,072
Iron bars, rods, angles, shapes, and sections	266	1,804	979
Steel bars, rods, angles, sections, and shapes	45,481	197,786	196,703
Iron plates and sheets	2	75	75
Universal plates	312	4,311	2,330
Steel plates, ⅛ in. and under ⅜ in.	749	9,701	4,741
Do., ⅜ in. and over	20,881	128,462	100,607
Blacksheets and black plate	21,184	100,186	100,325
Hoop and strip	8,059	50,018	41,124
Tinplate	27,449	138,851	127,041
Decorated tinplate	681	1,446	2,997
Galvanized sheets	12,564	74,121	59,331
Other (incl. tinned sheets, terne-plate, and ternesheets)	1,751	7,232	6,463
Railway and tramway construction material	24,141	125,837	131,330
Wire rods	3,564	14,233	17,150
Wire	9,780	47,355	43,670
Tubes, pipes, and fittings	65,369	308,234	325,601
Iron castings	289	4,628	874
Steel castings	204	956	788
Forgings	332	1,538	1,757
TOTAL	256,047	1,245,922	1,217,248

THE REGISTERED OFFICE of Hilger & Watts, Limited, scientific instrument makers, is now at 123, Camberwell Road, London, S.E.5, and the office of the registrar is at 98, St. Pancras Way, N.W.1 (telephone: GULliver 5636).

BY going to the Continent and bringing back some of the sub-contract work to this country, a Clyde engineering firm, Cockburns, Limited, has found at least part of the answer to the drift of orders to German shipyards. A European sales co-ordinator, appointed earlier this year, looks after the considerable volume of orders which they receive from abroad.

Batch and Continuous Sand Mixers





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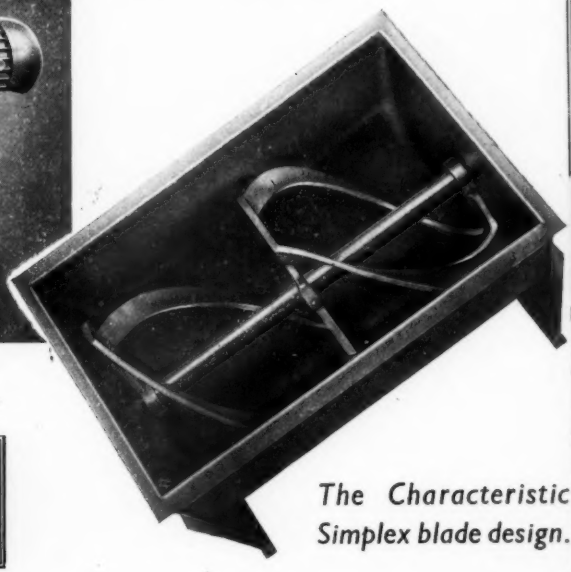

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Raw Material Markets

Iron and Steel

The supply of pig-iron to the foundries is now easier and demands are being met much more readily than for some time past. Production of hematite and low-phosphorus iron is maintained; outputs of both grades have been increased and, with the reduced pressure for supplies from some of the engineering foundries, producers are able to provide quantities more in keeping with demands. Some of the engineering foundries are not taking up their normal tonnages. This applies mainly to those which supply castings to the motor-vehicle and allied trades, while the position is further aggravated by the new import cuts announced by the Australian Government. A shortened working week has for some time been found necessary by some of these foundries.

Other sections of the engineering and speciality foundries are busy. With the increased supplies of pig-iron they are now able to obtain, their outputs of castings are bigger and orders are completed more quickly. The refined irons are in fairly good demand, but, with the larger supplies of other suitable and cheaper irons available, the foundries are not now calling for the higher priced irons to the same extent as they were. High-phosphorus pig-iron is meeting the needs of the foundries using this grade—the light, jobbing, and textile foundries, and also some of the engineering concerns. The demand for light castings is not heavy and most of the foundries are in need of more work.

The furnaces producing basic steelmaking pig-iron are able to dispose of their outputs readily. The steelworks are clamouring for increased tonnages and it is only with the additional quantities they are receiving from abroad that they are able to obtain sufficient tonnages for current needs. More furnaces will be blown in later for the production of basic iron, which is the most needed of all pig-irons.

The re-rollers continue to be well occupied. They have good order-books for all their products and there is plenty of new business offered from home and oversea sources. Home consumers and stockists are utilizing rapidly all available supplies of small bars, light sections, etc., and are able to place further orders when the re-rollers can accept. Oversea buyers are also anxious to place additional business, but only a small proportion of this can be accepted.

Home steelworks are maintaining deliveries of steel semis at recent levels, but for many of the re-rollers these supplies are insufficient and they are glad to receive the material which is coming to hand from abroad. Special alloy and carbon steels are scarce and more of the smaller sized billets in 2 in. square are required. Some of the re-rollers would also be pleased to accept a larger proportion of untested steel to implement the orders on hand which call for this grade, but few, if any, producers will offer this.

Non-ferrous Metals

Tin prices on the London Metal Exchange rose sharply at the beginning of the week as a result of news of a one-day strike by 7,000 workers in Selangor and Perak on Monday, which gave added force to reports over the weekend of a general strike threat throughout the Malayan tin industry. But for the continuation of the steel strike in the United States, the advance, it is thought, might well have been steeper. Demand for tin is only fair, as consumers are showing caution both in London and New York, an attitude which may well prevail until the position in the US steel industry is resolved.

The first session of the International Tin Council, the governing body of the international tin agreement, has ended and its next meeting has been fixed for October 15. It was announced that the initial quotas to the buffer stock would become due on September 15. Among the officers elected to the council is Mr. W. K. Davey, a former chairman of the LME, who has been appointed buffer stock manager.

The copper situation shows little change. Further pressure must have been put on the US primary producers' price of 46 cents a pound when on Friday the Custom smelters' price was reduced by 2½ cents to 37½ cents a pound, which is equivalent to £300 a ton. On Monday, however, Phelps Dodge reduced its price from 46 cents to 40 cents and other producers are expected to follow suit. Demand in the States at this price is still poor and the market remains subdued. On the other hand, the unsettled labour conditions on the Rhodesian Copperbelt have helped the copper price to recover.

Demand for lead on both sides of the Atlantic is quiet. Trading in the US remains on the basis of 16 cents a pound and confidence in the stockpiling programme to absorb surplus metal in America and in Europe removes any threat to the present price. However, if the US steel strike is prolonged and the building programme has to be held up or curtailed, the surplus metal arising would be more than the stockpile could handle. In London, lead is also quiet, but the price remains relatively firm.

Zinc is quiet here and in New York, where trading continues on the basis of 13½ cents a pound, East St. Louis, for "Prime Western" grade. The market is holding up surprisingly well in the face of the steel strike which, if prolonged, must have a sharp impact on the demand for the metal.

To maintain the balance between aluminium supply and demand in the United Kingdom, it has recently been necessary to purchase high-cost metal outside Canada and to defray the cost of this material a surcharge of 30s. a ton on all virgin aluminium sold in the UK came into effect on July 1.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* July 5, £274 10s. to £275; July 6, £279 to £279 10s.; July 9, £280 to £280 10s.; July 10, £280 to £281; July 11, £284 to £284 10s.

Three Months: July 5, £274 10s. to £275; July 6, £279 to £279 10s.; July 9, £280 to £280 10s.; July 10, £279 10s. to £280; July 11, £281 10s. to £282.

TIN, Standard—*Cash:* July 5, £744 to £746; July 6, £737 10s. to £738; July 9, £749 to £751; July 10, £748 to £749; July 11 £742 to £743.

Three Months: July 5, £739 to £741; July 6, £732 10s. to £733; July 9, £743 to £744; July 10, £742 10s. to £743; July 11, £738 to £738 10s.

LEAD—*First half July:* July 5, £113 15s. to £114; July 6, £114 to £114 10s.; July 9, £114 to £114 5s.; July 10, £114 5s. to £114 10s.; July 11, £114 10s. to £114 15s.

First half October: July 5, £111 5s. to £111 10s.; July 6, £111 10s. to £111 15s.; July 9, £111 10s. to £111 15s.; July 10, £112 to £112 5s.; July 11, £112 10s. to £112 15s.

ZINC—*First half July:* July 5, £92 15s. to £93; July 6, £93 10s. to £93 15s.; July 9, £92 15s. to £93; July 10, £93 5s. to £93 10s.; July 11, £93 10s. to £93 15s.

First half October: July 5, £91 10s. to £91 15s.; July 6, £91 10s. to £91 15s.; July 9, £91 to £91 5s.; July 10, £91 10s. to £92; July 11, £92 to £92 5s.

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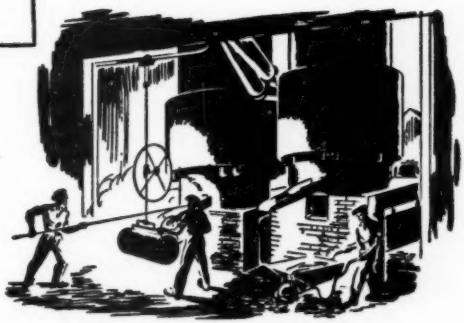

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

July 11, 1956

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £17 11s. 0d.; Birmingham, £17 3s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £20 8s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £20 12s. 3d.

Scotch Iron.—No. 3 foundry, £21 14s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £23 16s. 6d.; South Zone, £23 19s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £25 4s. 0d.; South Zone, £25 6s. 6d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent. :—N.-E. of England (local iron), £21 7s. 6d.; Scotland (Scotch iron), Zone S. 1, £21 14s. 0d.; Sheffield, £22 14s. 6d.; Birmingham, £23 2s. 0d.; Wales (Welsh iron), £21 7s. 6d.

Basic Pig-iron.—£18 3s. 0d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £48 0s. 0d. to £50 5s. 0d., scale 16s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £73 2s. 6d., scale 16s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 27s. 6d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £250 0s. 0d.; 38/40 per cent., £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 17s. 10d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 20s. 10d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent.C, £93 10s.0d. to £95 0s. 0d., basis 60 per cent. Cr, scale 29s. 9d. to 32s. 0d. per unit; over 6 per cent. C, £92 10s. 0d. to £93 0s. 0d., basis 60 per cent. Cr, scale 29s. 9d. to 32s. 0d. per unit; 2 per cent. C,* 2s. 1d. per lb. Cr; 1 per cent. C,* 2s. 1½d. per lb. Cr; 0.15 per cent. C,* 2s. 2½d. per lb. Cr; 0.10 per cent. C,* 2s. 2¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £249 0s. 0d.; 96/98 per cent., £259 0s. 0d. to £265 0s. 0d.

Ferro-columbium.—65/72 per cent., Nb + Ta, 22s. 6d. to 23s. 6d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £66 0s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £28 19s. 0d.; tested, 0.08 to 0.25 per cent. C, £29 19s. 0d.; hard (0.41 to 0.60 per cent. C), £31 0s. 6d.; silico-manganese, £39 10s. 0d.; free-cutting, £33 3s. 0d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £36 14s. 6d., silico-manganese, £39 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £34 13s. 6d.; basic, hard, over 0.41 up to 0.60 per cent., C, £35 16s. 0d.; acid, up to 0.25 per cent. C, £38 17s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £35 7s. 0d.; boiler plates (N.-E. Coast), £37 17s. 0d.; floor plates (N.-E. Coast), £36 16s. 0d.; sectional material, N.-E. Coast, £33 16s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested (4-ton lots), £36 3s. 0d.; flats, 5 in. wide and under (4-ton lots), £36 3s. 0d.; hoop and strip, £36 12s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £38 16s. 0d.; black sheets (hand mill), 17/20 g., £50 4s. 6d.; galvanized corrugated sheets, 24 g., £62 7s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £61 13s. 9d.; nickel-chrome, £85 10s. 6d.; nickel-chrome-molybdenum, £96 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £284 0s. 0d. to £284 10s. 0d.; three months, £281 10s. 0d. to £282 0s. 0d.; settlement, £284 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 8⅝d. per lb.; rods, 313s. 3d. per cwt. basis; 20 s.w.g., 346s. 6d. per cwt.

Tin.—Cash, £742 0s. 0d. to £743 0s. 0d.; three months, £738 0s. 0d. to £738 10s. 0d.; settlement, £743 0s. 0d.

Lead (Refined Pig).—First half July, £114 10s. 0d. to £114 15s. 0d.; first half October, £112 10s. 0d. to £112 15s. 0d.

Zinc.—First half July, £93 10s. 0d. to £93 15s. 0d. first half October, £92 0s. 0d. to £92 5s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £124 5s. 0d.; rolled zinc (boiler plates), all English destinations, £122 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £110.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 2⅞d. per lb.; rods, drawn, 3s. 1¼d.; sheets to 10 w.g., 300s. 9d. per cwt.; wire, 2s. 10¾d.; rolled metal, 285s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £181; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £238; HTB2 (38 tons), — ; HTB3 (48 tons), £255.

Gunmetal.—BS1400, LG2 (85/5/5/5), £252; LG3 (86/7/5/2), £262; G1 (88/10/2/½), £305 ; (88/10/2/1), £304.

Phosphor Bronze.—BS1400, PB1 (AID released), £340 per ton.

Phosphor Bronze Strip, etc.—Strip, 412s. 9d. per cwt.; sheets to 10 w.g., 437s. 3d. per cwt.; wire, 4s. 3⅝d. per lb.; rods, 3s. 7¾d.; tubes, 3s. 6d.; chill cast bars: solids 3s. 8d., cored 3s. 9d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 0d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 4⅜d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 3¾d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 4d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £86 0s. 0d. Nickel, £519 0s. 0d. Aluminium ingots, £189 0s. 0d.; aluminium bronze (BS1400), AB1, —; AB2, —. Solder, brazing, BS1945; type S (50/50), 3s. 1d. per lb., type 9 (54/46), 3s. 4¼d. per lb.

* Average 68-70 per cent.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

KOREA, July 18—Iron pipes, copper tubing, rolled steel, coil springs, gears, bearings, pumps, etc., for the Office of Supply, Government of the Republic of Korea, Seoul. (ESB/16200/56/ICA.)

BURMA, July 17—5,000 polished brass cocks, for the Chief Controller, Union of Burma Purchase Board, Rangoon. (ESB/16921/55.)

NEWARK, July 17—Supply and laying of approximately 1,700 yds. of 3-in. spun-iron Class "B" water main, with the necessary fittings, for the Rural District Council. Mr. W. M. Taylor, 21, Lombard Street, Newark, (Notts).

PAKISTAN, July 16—Equipment for agricultural workshops, for the Director-General of Supply and Development, Government of Pakistan. (ESB/17055/56.)

BURMA, July 16—Centrifugal pumps, for the Chief Controller, Union of Burma Purchase Board. (ESB/16963/56.)

EIRE, August 3—Supply and erection of two 4,000 g.p.h. pumping sets combining centrifugal pumps and electric motors with all necessary accessories, for the Westmeath County Council. P. H. McCarthy & Son, consulting engineers, 26, Lower Leeson Street, Dublin. (Deposit, £5.)

INDIA, July 16—Mobile cranes, for the Bombay Port Trust. (ESB/17089/56.)

INDIA, July 18—Hand tools, machine tools, meters, measuring instruments, etc., for the Government of India, India Supply Mission, Washington. (ESB/16431/56/ICA.)

INDIA, August 6—Generating plant and indoor switchgear, for the Government of Andhra Department of Electricity. (ESB/16634/56.)

PORTUGUESE EAST AFRICA, August 14—Parallel mechanical lathe, for the Ports, Railways, and Transport Department, Beira. (ESB/16590/56.)

Board Changes

BOULTON & PAUL, LIMITED—Mr. P. W. Gamble has been appointed a director.

GLOUCESTER RAILWAY CARRIAGE & WAGON COMPANY, LIMITED—Sir Eric Speed has been appointed a director.

WILLIAM DOXFORD & SONS (SHIPBUILDERS), LIMITED—Mr. William Jobling, technical manager of the shipyard, has been appointed a director.

SHORT BROS., LIMITED—Mr. G. D. Short, outside yard manager of the company's Sunderland yard, has been appointed a director of the company.

WILLIAM DOXFORD & SONS (ENGINEERS), LIMITED—Mr. James Albert Hardy, technical manager, and Mr. Percy Jackson, research and development manager, have been appointed directors.

BAKELITE, LIMITED—Mr. W. B. H. Gallwey, chairman of British Acheson Electrodes, Limited, has been appointed a director. Mr. Percival Huffman, a joint vice-chairman, has resigned from the board in consequence of his retirement from active business.

Changes of Name

Among the companies which have recently changed their names are those listed below. The new titles are given in parentheses.

BILLY TOOLS COMPANY, LIMITED, 14, George Street, London, E.C.4 (F. Piers Assets, Limited).

LAMFORTE, LIMITED, machine makers, etc., of Langley Road, Pendleton, Salford (Rondicast, Limited).

PORTOBELLO STEEL WORKS, LIMITED, Pitt Street, Sheffield (Portobello Steel Metal Works, Limited).

G. W. GROOM ENGINEERING, LIMITED, 70, Woodbine Grove, London, S.E.20 (G. W. Groom & Company, Limited).

LOMA ELECTRONIC EQUIPMENT, LIMITED, 27/29, Union Street, London, S.E.1 (Automa Engineering Group, Limited).

LOW PHOSPHORUS
REFINED & CYLINDER
HEMATITE
MALLEABLE
DERBYSHIRE
NORTHAMPTONSHIRE
SWEDISH CHARCOAL

PIG-IRON

WILLIAM JACKS & CO. LTD.
LONDON, E.C.2.
Winchester House, Old Broad Street
London Wall 4774 (6 lines)

FERRO SILICON 12/14%
ALLOYS & BRIQUETTES
N.F. METALS & ALLOYS
LIMESTONE
GANISTER
MOULDING SAND
REFRACTORIES

And at:—

BIRMINGHAM, 2. 39, Corporation St., Midland 3375/6
LIVERPOOL, 2. 13, Rumford St., Central 1558
GLASGOW, C.2. 93, Hope Street, Central 9969

CLASSIFIED ADVERTISEMENTS

PREPAID RATES: Fifteen words for 7/6 (minimum charge) and 4d. per word thereafter. Box Numbers 2/6 extra (including postage of replies.) Situations Wanted 2d. per word.

Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, John Adam House, 17/19, John Adam Street, Adelphi, London, W.C.2. If received by first post Monday advertisements can normally be accommodated in the following Thursday's issue.

SITUATIONS WANTED

EXPERIENCED FOUNDRY SUPERVISOR seeks position with progressive Iron Foundry. Would introduce up to 2 tons jobbing castings per week. 60 miles radius London. Box EF184, FOUNDRY TRADE JOURNAL.

WORKS ENGINEER (36) requires new top level appointment, comprehensive experience development/installation/maintenance management—mechanised foundries, associated plant, machine shops. Good background, qualifications. 4-figure salary and housing essential. Box WE1001, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER/TECHNICIAN, Iron and Non-Ferrous. 18 years' managerial experience. — Box FM200, FOUNDRY TRADE JOURNAL.

CORESHOP FOREMAN (44), 28 years in iron and steel foundry, desires change. Experienced in all classes of modern mechanised foundry practice. Used to trainees, 15 years' supervision.—Box CF198, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

BRONZE FOUNDRY. Young man, 25/35, wanted to control production and assist in sales of Chill Cast Bar. Some experience in this type of casting desirable, general foundry experience essential. Excellent salary and prospects. —CHARLES CARR, LTD., Grove Lane, Smethwick

FOUNDRY FOREMAN (working) required for Malleable and Grey Iron Foundry.—Apply, giving full details, particularly of actual moulding experience, in confidence. State wages required, etc.
Apply: ALFRED H. MOULD & SONS, LTD., Stafford Street, Walsall.

FOUNDRYMAN, £1,500—£2,000 class, seeks change in executive position. Experienced all aspects of Ferrous Foundrywork. Slight experience shell moulding.—Box FS203, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER required for iron and/or light alloy foundries in South East. Pension Scheme and Employees Share-Holding Scheme.—Apply, stating age, experience and salary required, to Box FF202, FOUNDRY TRADE JOURNAL.

IRONFOUNDRY FOREMAN wanted. Experience in a wide range of General Jobbing work up to 5 tons essential and also in Machine Moulding and the plating of patterns. Must be able to estimate and work from drawings and possess a sound knowledge of Cupola practice and Foundry Organisation. Preston area. Write with full details and state salary required to Box IW205, FOUNDRY TRADE JOURNAL.

ASSISTANT METALLURGIST for Malleable Iron Foundry in Midlands. Experience of modern melting practice and sand control essential. Applications in writing, stating age, qualifications and salary required to Box AM193, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

FOUNDRY METALLURGIST.

A VACANCY exists for a light alloy foundry metallurgist in a modern foundry in Eastern Ontario. The following are essential qualifications which the applicant must possess: A degree or its equivalent, a minimum of five years experience in metallurgical control in a light alloy foundry, preferably one handling both magnesium and aluminium, a sound knowledge of metal melting and alloying, sand control, heat treatment and radiography, and an active interest in the technicalities of production of Class 1 castings for aircraft. Housing accommodation can be made available for a suitable applicant. All applications should be made by air mail, giving full details of past experience and qualifications together with a recent photograph of the applicant addressed to the MANAGER, Light Alloys Limited, Haley, Ontario, Canada.

FOUNDRY FOREMAN, experienced executive for Roll Foundry and other castings.—State experience, qualifications, and wages required, Box FF974, FOUNDRY TRADE JOURNAL.

ASSISTANT TO SALES MANAGER required by William Cook & Sons (Sheffield), Ltd. Applicants should be between the ages of 25-35 years, and Technical education or Steel Foundry experience is essential as duties will comprise the estimating of weights from drawings, pricing of castings, etc. The position would be partly inside and partly outside. Replies, giving details of experience, salary expected, etc., will be treated in the strictest confidence.

PRACTICAL FURNACE MAN required to supervise smelting and refining operations. Applicants must be thoroughly conversant with oil and gas fire furnaces and should have good knowledge of fuel efficiency methods. Good salary and bonuses for right man according to ability. Five-day week. Company's Pension and Insurance Scheme available. Apply in the first instance in writing, in confidence, to MITCHAM SMELTERS, LTD., Red House Road, Mitcham Road, Croydon.

CHARGEHAND IRON MOULDER for London district. There are good prospects for a practical man, for whom accommodation can be provided. Apply Box CM188, FOUNDRY TRADE JOURNAL.

FOREMAN PATTERNMAKER required for Semi Mech. Foundry producing 100 tons per week High Duty Iron by machine and Sand Slinger. Reply stating full details of training and experience, together with salary required to FOUNDRY MANAGER, Sykes & Harrison, Ltd., Bangor, North Wales.

FOUNDRY METALLURGIST.

LARGE Engineering Company in the East Midlands desires to engage a young energetic man with experience of cupola control and sand control. Knowledge of non-ferrous melting desirable. Must be capable of displaying initiative and have an interest in development work. Excellent welfare and sports facilities. House available. Write stating age, qualifications, experience and salary desired to Box FM190, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

FOUNDRY MANAGER required for Iron Foundry in South Yorkshire area producing 40 tons per week. Applicant must have experience in all aspects of machine and floor moulding, metal control and the handling of labour. Good opportunity for the right man interested in joining progressive firm in the process of expanding. Applications, stating age, experience, and salary required, to Box FR201, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER required for Modern Semi-mechanised Brass Foundry in the Birmingham area. Applicants must have practice and technical knowledge in the production of Brass and Gun-Metal castings, Brass gravity Die Casting and Core Blowing equipment. Excellent position for the right person. Write in detail enclosing copies of testimonials and salary required.—Box FB204, FOUNDRY TRADE JOURNAL.

OPPORTUNITY exists for a capable, young and energetic METALLURGIST, to set up a laboratory and establish technical control in an iron foundry producing castings for rolling stock. Previous experience of melting in the cupola is necessary and experience of electric melting desirable. The laboratory to be set up would eventually serve the whole of the manufacturing establishment. Replies, which will be treated in confidence should be addressed to the MANAGING DIRECTOR, Charles Roberts & Co., Ltd., Horbury Junction, Wakefield.

MACHINE MOULDER wanted.—MOYLE, Iron Foundry, Hampton Wick.

IRON FOUNDRY MANAGER required for Engineering firm in the Nottingham area, to take complete charge of the Foundry, which at the moment is producing 20 tons Grey Iron Castings per week. Applicants should have a sound practical knowledge of modern methods of production from loose patterns, and moulding machines, organising experience and ability to control. The position is intended to be permanent and progressive. Pension scheme, good salary offered to the right man. Write stating age and giving, in confidence, full particulars of training and experience, also salary required, to the Personnel Manager, Box IM207, FOUNDRY TRADE JOURNAL.

MECHANICAL AND STRUCTURAL DESIGN DRAUGHTSMAN for Foundry Engineer's Department for development project work. Pension scheme. Write in confidence to the STAFFING OFFICER, The Stanton Ironworks Co., Ltd., near Nottingham.

YOUNG METALLURGIST required for an old established but progressive non-ferrous foundry in Melbourne, Australia. Experienced in shell moulding and chill casting an advantage. Applicants should send details of their careers with copies only of testimonials and use air mail paper, to Box 2999, FOUNDRY TRADE JOURNAL